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November 15, 1990

Energy Research Abstracts

Abstracts 46335–48070

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of nonreport literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for online searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire database is available through commercial online vendors.

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Managing Editor, Audrey B. Smith
Technical Editor, Robert W. Rutkowski

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
10. **Date of publication.** If not known, a processing date is in brackets.
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15. **Sponsoring organization.**
16. **Contract or grant number.**
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18. **Conference title, location, and date,** if applicable.
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20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. **Wisconsin Univ., Madison (USA). Dept. of Physics.** [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. **Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.**

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020--: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA. Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

How To Order from the Availability Sources

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Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 20 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) The public should order from NTIS or from one of the other agencies listed in the citation. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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INIS Clearinghouse
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5285 Port Royal Road
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Books, conferences, and monographs The source for these publications is the publisher or the originating society, organization, or institution. DOE-supported conferences and individual papers reporting DOE-supported research may be available as reports from OSTI.

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816-363-4600

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National Translation Center
Washington, D.C. 20540
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United Kingdom

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
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TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope.*

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

0103 Preparation

Refer also to citation(s) 46354, 46377, 46379, 46382

46335 (DOE/MC/10637–2803, pp. 32, Paper 9) **Beneficiation of low-rank coals.** Potas, T.A. (Univ. of North Dakota, Grand Forks (USA)); Malterer, T.J.; DeWall, R.A.; Anderson, C.M. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

Current year objectives for the UNDEMRC Low-Rank Coal Beneficiation project are to: (1) complete equipment integration and modification of PDU facilities for physical cleaning, chemical cleaning and hot-water dried fuel production at a minimum of 200 lbs/hr, (2) perform and improve fuel production for various advanced combustion applications, (3) summarize process water treatment options and economics, (4) continue to determine the amenability of candidate test coals to physical and chemical cleaning methods and investigate alternate methods to established coal cleaning techniques, and (5) continue to evaluate methods and reagents to perform froth flotation of LRCs. Near-term objectives of the project for the period October through December 1988 were to: (1) improve pilot-scale physical coal cleaning methods and eliminate magnetite contamination of the product; (2) improve the continuous chemical coal cleaning method developed for pilot-scale production of clean fuels; (3) perform hot-water drying of the fuel after physical and chemical coal cleaning; (4) continue to support advanced combustion projects with cleaned, LRC fuels; (5) evaluate the effects of wet versus dry coal comminution on froth flotation performance; (6) conclude wastewater treatment studies and economics.

46336 (DOE/PC/88878–T7) **Coal surface control for advanced fine coal flotation: Quarterly report No. 6, January 1, 1990–March 31, 1990.** Fuerstenau, D.W. (California Univ., Berkeley, CA (USA)); Sastry, K.V.S.; Hanson, J.S.; Harris, G.; Sotillo, F.; Diao, J.; Yin, Y.; Somasundaran, P.; Harris, C.C.; Vasudevan, T.; Liu, D.; Li, C.; Hu, Weibai; Zou, Y.; Chen, W.; Choudhry, V.; Sehgal, R.; GhosCalifornia Univ., Berkeley, CA (USA); Columbia Univ., New York, NY (USA); Utah Univ., Salt Lake City, UT (USA); Praxis Engineers, Inc., Milpitas, CA (USA). 31 May 1990. 73p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88878. Order Number DE90016765. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The primary objective in the scope of this research project is to develop advanced flotation methods for coal cleaning in order to achieve near total pyritic sulfur removal at 90% Btu recovery, using coal samples procured from six major US coal seams. The ash content of these coals is to be reduced to 6% or less. Investigation of mechanisms for the control of coal and pyrite surfaces prior to fine coal flotation is an important aspect of the project objectives. A second major objective is to investigate factors involved in the progressive weathering and oxidation of coal that had been exposed to varying weathered degrees, namely, open, covered and in an "argon-inerted" atmosphere, over a period of twelve months. After regular intervals of weathering, samples of the three base coals (Illinois No. 6, Pittsburgh No. 8 and Upper Freeport PA) were collected and shipped to both the University of Pittsburgh and the University of California at Berkeley for characterization studies of the weathered material. Progress is described on weathering, washability studies (calorific value, ash analysis, pyritic sulfur rejection, variability analysis), coal grinding and flotation, pH effects and modification of surfaces on flotation. 26 figs., 20 tabs.

46337 (DOE/PC/88883–T6) **Development of the electrocoustic dewatering (EAD) process for fine/ultrafine coal: Seventh quarterly progress report period ending June 30, 1990.** Kim, B.C.; Criner, C.L.; Wu, H.; Senapati, N.; Chauhan, S.P. Battelle, Columbus, OH (USA). 10 Aug 1990. 14p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88883. Order Number DE90016766. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Battelle, in cooperation with the Electric Power Research Institute (EPRI) CQ, Inc., Ashbrook-Simon-Hartley (ASH), and Professor S. H. Chiang of the University of Pittsburgh, is developing an advanced process for the dewatering of fine and ultrafine coals. The advanced process, called Electroacoustic Dewatering (EAD), capitalizes on the adaptation of synergistic effects of electric and acoustic fields to commercial coal dewatering systems, such as belt filter presses. The project has the following objectives: To validate the expected technical feasibility and energy conservation/economic benefits of the EAD process as applied to fine (−100 mesh) and ultrafine (−325 mesh) coal; and to obtain data from a continuous, process research unit (PRU) in order to conduct a reliable economic analysis and to design commercial EAD filters as well as to promote adaptation of the process by the coal preparation industry. Progress is reported. 2 figs., 4 tabs.

46338 (DOE/PC/89904–T16) **High-sulfur coal research at the SIUC Coal Technology Laboratory: Quarterly progress report, April 1–June 30, 1990.** Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA); Southern Illinois Univ., Carbondale, IL (USA). Coal Extraction and Utilization Research Center. Jul 1990. 32p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-89PC89904. Order Number DE90016798. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research on high-sulfur coal through the Coal Technology Laboratory program at Southern Illinois University at Carbondale (SIUC) is divided into three general categories: coal science, coal preparation, and coal utilization. In the category of coal science, one study, the reactivity of whole coals, selected pure maceral fractions, and cleaned coal products, was completed this quarter. In the coal preparation category, three projects are currently underway: electro-osmotically enhanced dewatering/deliquoring of fine-particle coal, and the indentation fracture of coal, pyrite/minerals liberation under different freezing temperature conditions, and development of an impact grinder. The coal utilization category has one project in progress: refinement of the theoretical model of the pulse combustor.

46339 (GAO/RCED–90-67) **Fossil fuels: Pace and focus of the Clean Coal Technology Program need to be assessed.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 38p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

Coal, one of America's most abundant energy sources, is also a major cause of air pollution and acid rain. Since 1984 DOE's Clean Coal Technology program has sought to financially assist private industry in demonstrating the commercial application of emerging clean coal technologies. So far Congress has appropriated $2.75 billion for the program. DOE has requested project proposals from industry through three separate solicitations (or rounds) and has chosen 39 projects. This paper reports that DOE's elaborate process for evaluating, ranking, and selecting round-two project proposals provides reasonable assurance that proposals were consistently and thoroughly evaluated and that projects were chosen using the applicable criteria. However, of the 16 projects DOE selected in round two, 12 were ranked weak in meeting certain of the evaluation criteria.

46340 (IS–4958) **Chemical pretreatment of coal in a stirred ball mill: Fossil energy quarterly report, 1 January 1988–31 March 1988.** Birlingmair, D.; Burkhart, L.; Tampy, G.; Pollard, J. Ames Lab., IA (USA). Jun 1988. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90016715. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Techniques were studied to alter and control the surface chemistry of ultrafine coal and mineral particles during comminution in a stirred ball mill to enhance liberation and subsequent physical separation. Three-phase (kerosene-liquid-solid) contact angle measurements were taken with kerosene as the oil phase; with acidic, basic, neutral, and sodium dithionite solutions constituting the aqueous phase, and organic-rich and mineral-rich fractions of Upper Freeport coal constituting the solid phase. The hydrophobic/hydrophilic effect of the aqueous solutions on the organic-rich and mineral-rich fractions was compared to the results of microbubble froth flotation. Continuous microbubble column flotation experiments were also conducted and the effect of several variables investigated. In general, slow feed rates, high frother concentration and high frit pressure yielded better results. The use of oxone, a peroxygen triple salt, as a chemical reagent during grinding and pretreatment prior to beneficiation, was explored. The acidic surface functional oxygen groups were studied to more fully understand the changes on coal samples affected by chemical pretreatment. 6 refs., 3 figs., 7 tabs.

46341 (IS–4969) **Sonic enhancement of physical and chemical cleaning of coal: Fossil energy quarterly report, April 1, 1988–June 30, 1988.** Buttermore, W.H.; Slomka, B.J.; Dawson, M.R. Ames Lab., IA (USA). Sep 1988. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90016716. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research efforts continued with laboratory tests to characterize the effects of sonication on coal and mineral particles and their surfaces. Several techniques were employed to compare samples of sonicated and unsonicated Illinois seam coal. In particular, the effects of acoustic cavitation on particle size distribution and resulting mineral redistributions were studied. Results indicate that coal and mineral particles undergo extensive breakage in the coarser sizes between 8 mesh and 30 mesh (US sieve), with a significant accumulation of fine material in the size range below 200 mesh. Also, a novel method was developed for the characterization of coal and mineral surfaces exposed to sonication and other cleaning processes. The new method employs a unique flow cell to permit the dynamic measurement of dye adsorption on coal and mineral particle surfaces. The rates and extents of the adsorption of ionic dyes on Illinois No. 6 coal were highly dependent on mineral content and particle size of ground coal samples. 4 refs., 7 figs., 3 tabs.

46342 (IS–4985) **Mechanisms for selective coalescence of coals: Fossil energy quarterly report, October 1, 1988–December 31, 1988.** Wheelock, T.D.; Markuszewski, R.; Fan, C.W.; Drzymala, J.; Allen, R.W.; Hu, Y.C.; Tyson, D.; Xiaoping, Qiu; Lessa, A. Ames Lab., IA (USA). Dec 1988. 19p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017299. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The study of basic mechanisms which underlie various processes for cleaning coal by selective agglomeration with oil was continued. Upper Freeport coal, used extensively in this study, was further characterized by measuring its heat of wetting in dilute salt solutions ($CaCl_2$/NaCl/$FeCl_3$) range of pH. The effect of mild surface oxidation on the agglomeration characteristics of Lower Kittanning coal was investigated because of the large pyritic sulfur content of this material. Oxidation was performed by exposing a thin layer of the finely ground coal to air at room temperature for 10 days. When the ground material was subsequently agglomerated with heptane, the agglomeration recovery of the oxidized coal was only slightly less than that of unoxidized coal. However, the sulfur content was lower than that of agglomerated coal which had not been oxidized. The effect of pyrite surface properties on the separation of coal/pyrite mixtures was further studied by combining acid-cleaned mineral pyrite with No. 2 gas seam coal from Raleigh Country, West Virginia. The separation was not as good as that obtained previously with mixtures involving mineral pyrite which had been mildly oxidized. 1 ref., 12 figs., 3 tabs.

46343 (IS–4993) **Chemical pretreatment of coal in a stirred ball mill: Fossil energy quarterly report, 1 January 1989–31 March 1989.** Birlingmair, D.; Burkhart, L.; Tampy, G.; Pollard, J. Ames Lab., IA (USA). Jul 1989. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017300. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The results of using a reducing agent (sodium dithionite) as an additive during the grinding and beneficiation of an Illinois No. 6 run-of-mine coal are shown. Earlier work had indicated that with use of the additive improved sulfur removal from Upper Freeport and Lower Kittanning run-of-mine coals could be achieved using physical beneficiation techniques such as oil agglomeration and microbubble flotation. For the best results with the earlier coal samples, it was seen that the additive had to be present both during grinding and separation for Upper Freeport coal, and during grinding only for Lower Kittanning coal. For the Illinois No. 6 coal used in this study, the results are sensitive not only to the stage in which the additive is added, but also to the type of separation technique used. It is evident that the additive does cause a depression of sulfide minerals, and thus improves sulfur removal, both during microbubble flotation and oil agglomeration. However, although the additive has no detrimental effects on the recovery of clean coal or ash reduction during oil agglomeration, significant decreases in coal recovery and ash reduction are observed if the additive is used in microbubble flotation. The possible reasons for this difference are discussed. 7 refs., 3 figs., 2 tabs.

46344 (IS–4994) **Mechanisms for selective coalescence of coals: Fossil energy annual report, October 1, 1987–September 30, 1988.** Wheelock, T.D.; Markuszewski, R.; Fan, C.W.; Labuschagne, B.C.J.; Venkatadri, R.; Drzymala, J.; Allen, R.W.; Hu, Y.C.; Tyson, D.; Xiaoping, Qiu; Lessa, A. Ames Lab., IA (USA). May 1989. 60p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017301. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

To study the basic mechanisms which underlie various processes for cleaning coal by selective agglomeration with oil, a large number of experiments were conducted in which fine-size coal, graphite, mineral pyrite, or a mixture of these materials was agglomerated with heptane under a variety of conditions (i.e. oxidation, in the presence of Ca^{++} or Mg^{++}, treatments with sodium oleate or humic acid). The results were related to the surface properties of the materials and to other important parameters of the system. Thus, when aqueous particle suspensions of graphite or various types of coal were agglomerated individually with heptane, the percent recovery correlated very well with the measured induction time of the solids which in turn correlated closely with the heat of immersion. 3 refs., 54 figs.

46345 (IS–4997) **Mechanisms for selective agglomeration of coals: Fossil energy quarterly report, January 1, 1989–March 31, 1989.** Wheelock, T.D.; Drzymala, J.; Allen, R.W.; Hu, Y.C.; Tyson, D.; Xiaoping, Qiu; Lessa, A. Ames Lab., IA (USA). May 1989. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017303. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The investigation of basic mechanisms which underlie various processes for cleaning coal by selective agglomeration with oil was continued. Further measurements were made of the heat of wetting or immersion of various types of coal and graphite. The heat of immersion is an indicator of hydrophobicity which appears to correlate with other indicators such as induction time. The heat of immersion of Upper Freeport coal was increased greatly by heating the material in air at 150°C for 7 days. The increase appeared due to a combination of surface oxidation and other factors such as an increase in the heats of rehydration and swelling. Leaching Upper Freeport coal with boiling hydrochloric acid increased the heat of immersion at low pH. Further consideration was given to potential pyrite depressants and quebracho was selected for evaluation. The degree of suppression was observed to depend on the nature of the solids and the amount of agglomerant (heptane) as well as the concentration of quebracho. 12 figs.

46346 (IS–4998) **Sonic enhancement of physical and chemical cleaning of coal: Fossil energy quarterly report, January 1, 1989–March 31, 1989.** Buttermore, W.H.; Slomka, B.J.; Dawson, M.R. Ames Lab., IA (USA). May 1989. 13p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order

Number DE90017304. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During this reporting period, laboratory tests were performed to investigate the effects of sonication on the desliming of Illinois No. 6 coal. Desliming removes fine clay particles which can interfere with surface-controlled cleaning processes and thus is an important step prior to beneficiation procedures such as flotation or oil agglomeration. A 10-kHz Swen Sonic near-field apparatus was configured for continuous-rinse desliming of coal in the presence of sonic waves. Samples of minus 200 mesh (74 μm) undersize material dislodged from coal as a result of exposure to sonic energy were collected and analyzed. Ash content was reduced by 21.9% as a result of exposure to pulsed sonic energy over a 4-minute period. Also during this quarter, fundamental studies continued with the application of zeta potential and induction time measurements. This work will help to quantify the effects of sonication on coal and mineral surfaces and will aid in determining how sonication can best be used to improve surface-controlled coal cleaning techniques. 4 refs., 3 figs., 3 tabs.

46347 (IS–5005) **Sonic enhancement of physical and chemical cleaning of coal: Fossil energy quarterly report, April 1, 1989–June 30, 1989.** Buttermore, W.H.; Slomka, B.J.; Dawson, M.R. Ames Lab., IA (USA). Jul 1989. 19p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017307. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

the primary objective of this project is to enhance the physical and chemical separation of sulfur and ash-forming mineral matter from coal through the novel application of sonic energy. This quarter, flotation experiments using a Hallimond tube verified that floatability can be restored to oxidized Illinois No. 6 coal as a result of exposure to sonication for 30 seconds at 10 kHz using the Swen Sonic Probe. A new leaching technique was developed to provide a dynamic measurement of surface oxidation as indicated by changes in acidity. A direct correlation is observed between oxidation time and the acidity of effluents from closely sized coal samples. Sonication was effective in removing acidic solubles from leached surfaces of oxidized coals. Reference tests, where oxidized coals were washed but not sonicated, and then subjected to flotation, indicate that the leaching and acidity measurement tests, while useful as a measure of exposure to oxygen, are not sufficient to predict coal floatability. Coal sample characterization continued with a washability analysis performed on a recently collected sample of Illinois No. 6 coal. Information was obtained on particle size distribution, ash, and sulfur content for a sample of Upper Freeport coal. 6 refs., 7 figs., 5 tabs.

46348 (IS–5006) **Chemical pretreatment of coal in a stirred ball mill: Fossil energy quarterly report, April 1, 1989–June 30, 1989.** Birlingmair, D.; Burkhart, L.; Tampy, G.; Chmielewski, T.; Pollard, J. Ames Lab., IA (USA). Oct 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017308. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order to assess the effect of pretreatment with sodium dithionite on physical cleaning of coal, flotation tests were conducted on organic-rich and mineral-rich fractions of Upper Freeport, Lower Kittanning, and Illinois No. 6 run-of-mine coals. The organic- and mineral-rich fractions were previously obtained by gravity separation. Flotation rate constants (which are one measure of the floatability of particles) were determined from collectorless flotation of the organic-rich fraction of Illinois No. 6 coal and compared to the concentration of sodium dithionite (a reducing agent) in the flotation medium. The rate constants were also evaluated for tests conducted with solutions of sodium dithionite that were completely oxidized by exposure to atmospheric oxygen. Additional flotation tests were also conducted with the same fractions of the coals using kerosene as a collector. The responses of the different coals varied but followed a similar pattern. Preliminary flotation tests were also conducted with pyrite samples from coal and from ore sources. The results showed that flotation behavior can vary significantly for pyrites from different sources. 7 refs., 4 figs.

46349 (IS-M–621) **Development of a method for characterizing changes in coal and mineral surfaces resulting from beneficiation processes.** Slomka, B.J.; Seward, K.J.; Dawson, M.R.; Buttermore, W.H. Ames Lab., IA (USA). [1989]. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. (CONF-890305–1: 7. international coal testing conference, Charleston, WV (USA), 21-23 Mar 1989). Order Number DE90016702. Source: NTIS, PC A03/MF A01 - OSTI.

A novel method was developed for characterizing changes in coal and mineral surfaces resulting from sonication and other cleaning processes. This method employs a unique flow-cell to permit the dynamic measurement of dye adsorption on coal and mineral particle surfaces. The rates and extents of adsorption of ionic dyes on Illinois No. 6 coal were found to be dependent on mineral content and particle size of ground coal samples. A significant correlation was observed between the adsorbed quantity of dye and the total mineral content of coal. In preliminary experiments with methylene blue dye, clay was found to absorb significantly more of the dye than quartz, pyrite, calcite, or "clean coal" surfaces. By using dyes of differing adsorption selectivity, it is demonstrated that sonication reduces the apparent mineral content on the surface of coal. 9 refs., 7 fig., 3 tabs.

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Refer also to citation(s) 46335, 46339, 46472, 46473, 46733, 47184, 47281

46350 (BNL–44981) **Mild gasification mechanism and char conversion.** Fallon, P.; Sundaram, M.S.; Steinberg, M. Brookhaven National Lab., Upton, NY (USA). [1990]. 9p. Sponsored by U.S. DOE Energy Research; U.S. DOE Fossil Energy. DOE Contract AC02-76CH00016. (CONF-900853–3: Gasification and gas stream cleanup systems, Morgantown, WV (USA), 28-30 Aug 1990). Order Number DE90017204. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this program is to obtain process chemistry data for (1) the mild gasification of several ranks of coal in a stirred moving bed reactor as function of process variables and (2) the hydrogasification of char from the mild gasification of Wyodak coal in a countercurrent moving bed reactor. Mild gasification experimental runs are being preformed in a long stirred moving-bed reactor constructed of a high alloy stainless steel. The feed to the moving bed reactor is through an entrained flow tube long reactor which preheats the coal particles with cocurrent sweep gas up to 400°C, at which temperature there is essentially no formation of condensible coproducts. The yields of coproducts are than obtained as a function of several parameters. In the second part of the program, a moving bed countercurrent flow reactor. The reactor is designed for a gas flow rate below the incipient fluidization velocity of the column char. Char from the mild gasification of Wyodak subbituminous coal will be initially used in this investigation. 1 ref., 11 figs., 3 tabs.

46351 (CRIE-W–89026) **Reaction analysis of combustion for coal derived gaseous fuel. 2.: Study on fuel-NOx formation.** Yamauchi, K.; Sato, M.; Nakata, T. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Jan 1990. 27p. (In Japanese). Order Number DE90517067. Source: NTIS (US Sales Only), PC A03/MF A01.

In order to establish low NO_x combustion techniques for the gas turbine combustor to be used for coal gasification, selection of elementary process model, evaluation of model, and comparison of the results of the experiments and its analysis, were made in this paper, on fuel NO_x formation characteristics, burning coal derived gasous fuel, using reaction kinetics. In the elementary process model, following steps were assumed: methane and NH_3 reacts with radicals such as O, OH and H forming intermediate products, then these intermediate products react each other forming HCN, and HCN is further converted to NO and N_2. As to the result of the study on premix flame of methane containing NH_3, the result of the experiment agreed with the result of the analysis, and this reaction model was considered to be appropriate. About the tendency that in coal derived gaseous fuel containing a little methane, NO_x conversion ratio was lowered under the conditions in which the fuel of primary combustion zone was excessively dense at two stage combustion, and that a primary combustion ratio in which the

conversion ratio to NO_x was lowest, came into existence, the result of the experiment using elementary combustion equipment agreed with the result of the analysis. 16 refs., 12 figs., 3 tabs.

46352 (DOE/MC/10637–2803, pp. 24, Paper 6) **Liquefaction reactivity of low-rank coals.** Olson, E.S. (Univ. of North Dakota, Grand Forks (USA)). North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The first objective of this project is to investigate and test mechanisms that cleave carbon-oxygen bonds during liquefaction processing of low-rank coals. Research efforts will address the quantity and distribution of oxygen-containing components in coal and products resulting from low-severity or first-stage liquefaction; the reactivity of these components to a variety of hydrogenation reagents and treatments; the characterization of these coal components and their subsequent products by oxygen functional group analysis and appropriate molecular weight determinations; and the development of methods to cleave carbon-oxygen bonds that are resistant to, or formed by, mild low-rank coal liquefaction conditions. The second objective of this project is to identify the quantity and nature of hydroaromatic structures present in low-rank coal or resulting from conditions typical for first-stage, mild liquefaction.

46353 (DOE/MC/10637–2803, pp. 37, Paper 7) **Gasification ash and slag characterization.** Kalmanovitch, D.P. (Univ. of North Dakota, Grand Forks (USA)). North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall objective of this project is to develop a unified picture of the ash formation and behavior in coal gasification systems. In particular, the project aims to provide data on the behavior of ash and how it affects gasifier operation. The project is divided into four tasks. The first task involves the characterization and identification of mechanisms responsible for the complex mineral transformations that coal minerals exhibit in gasification systems. This involves the generation of ash and slag samples in bench-scale units simulating gasification environments using both high- and low-rank coals. In addition, model mixtures of minerals common to coal, acetic acid salts of various alkali and alkaline earth elements, and iron oxalate will be studied under simulated gasification atmospheres in the laboratory. The second task involves the study of vaporization of inorganic constituents during gasification processes. This will include the use of a computer simulation model of solid-gas-liquid phase equilibria in high-temperature (1,000-2,000 K) systems. The third task evaluates slag viscosity behavior under reducing conditions. The task will involve the study of compositional and rheological properties of slag produced from both reduced and oxidized coal ashes and the development of a predictive viscosity model. The objectives for this reporting period were to: (1) continue analysis of chars from a suite of coals prepared using the pressure pyrolysis unit; (2) continue development of a computer code (PHOEBE) for determining high-temperature complex phase equilibria; (3) compile a surface tension data base for a wide range of aluminosilicate silicate slags; (4) develop techniques to determine sintering behavior of coal ashes.

46354 (DOE/MC/10637–2803, pp. 19, Paper 12) **Direct liquefaction of low-rank coals.** Rindt, J.R. (Univ. of North Dakota, Grand Forks (USA)); Hetland, M.D.; Knudson, C.L. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

One method of upgrading coal in a liquefaction process is the ChemCoal Process. The process uses chemical methods to transform coal into clean solid and liquid products. It features low-severity conversion of coal in a phenolic solvent, using an alkali promoter and carbon monoxide as the reductant. Oil agglomeration has been used to reduce the ash and mineral matter in bituminous coals to obtain a product with increased heating value, reduced moisture, and lower sulfur content. This method can be used to produce a clean coal feedstock for liquefaction. The primary objective of this project is to expand the scientific and engineering data base of LRC liquefaction by investigating direct liquefaction processes that will produce the most competitive feedstocks or liquid fuels. Work which was scheduled for the third quarter of the current program year (4/88-3/89) consists of completion of the ChemCoal Process verification tests and utilization testing of the ChemCoal Process solid product as well as the continuation of the ChemCoal economics update, studies of LRC agglomeration, and the study of hydrogen transfer during the ChemCoal Process. Production of samples of LRC-derived solvent for use in later co-processing tests was also scheduled. The specific efforts included in these tasks are discussed in the following paragraphs.

46355 (DOE/MC/10637–2803 Paper 15, 122) **Mild gasification.** Ness, R.O. Jr. (Univ. of North Dakota, Grand Forks (USA)). North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The objective of this project was to perform a preliminary evaluation on the mild gasification of North American low-rank coals using a 1-lb/hr CFBR. Tests were performed to determine product yields and to analytically assess co-products for use as metallurgical coke substitutes, diesel blending agents, and chemical production feedstocks. End-use product testing was not included in the project. this effort provided data on basic operating parameters for process scale-up to a 100-lb/hr level. Specific tasks in this project were to: (1) define the test matrix; (2) determine preliminary yields to assess the CFBR design; (3) determine analyses necessary for material balances; (4) estimate coal and char fluidization and entrainment velocities for use in design of the CFBR; (5) design and construct the CFBR; (6) shakedown the CFBR; (7) complete the test program; (8) correlate data for reporting.

46356 (DOE/MC/22049–2797) **Fundamental mechanisms of coal gasification: Final report.** Griffin, T.P.; Ko, G.H.; Sanchez, D.M.; Hagaligol, M.R.; Hsu, J.S.; Peters, W.A.; Howard, J.B. Massachusetts Inst. of Tech., Cambridge, MA (USA). Nov 1989. 95p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85MC22049. Order Number DE90000454. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The goal of this project was to obtain improved quantitative understanding of certain features of coal devolatilization of significant interest for coal gasification technology, for basic coal science, and for coal utilization in general. The work features systematic experimental and related mathematical modeling studies of reactions of newly formed coal pyrolysis tars within pyrolyzing coal particles and of how coal type affects the rapid devolatilization behavior of coal. Extensive new data bases were provided on these phenomena and mathematical models and/or correlations were developed for: (1) intra-particle transport and secondary reactions for coal pyrolysis tars; (2) effects of coal type and total pressure on total pyrolysis tar yield; (3) effects of heating rate on global coal devolatilization rates; and (4) effects of coal type on global rates of weight loss in rapid devolatilization.

46357 (DOE/MC/22063–2843) **Investigation of reaction of heteroatoms during coal gasification: Final report.** Bal, B.S.; Bal, R.B.; Stock, L.M.; Zabransky, R.F. Institute of Gas Technology, Chicago, IL (USA). Mar 1988. 188p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85MC22063. Order Number DE90009655. Source: NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The disposition of the heteroatomic structures contain coal during gasification. The understanding of the behavior of the sulfur containing entities is of special importance because of environmental concerns. This investigation deals with the correlation between the structural incorporation of sulfur and oxygen and the production of hydrogen sulfide, sulfur dioxide, carbonyl sulfide, carbon disulfide as sulfur containing gases and carbon dioxide, carbon monoxide, and methane as nonsulfur containing gases. Well characterized sulfur structures were introduced into bituminous coal in low concentration by 0-alkylation methodology into the coal structure so their behavior at elevated temperatures could be monitored. Pyrolysis experiments were performed using a wire screen reactor and temperature programmed pyrolysis high-resolution mass spectroscopic techniques. The relationships between the structural components and the evolution of gases is discussed. Finally, the

structural mobility of the anchoring group during the pyrolysis has been demonstrated. For example, the 2-butylthiophene fragment incorporated in coal structure was converted into benzothiophene along with many intermediate compounds. In addition, a few oxygen and nitrogen containing fragments were also introduced in coal structure and the coals were subsequently pyrolyzed. However, their behavior during the pyrolysis was not extensively studied. 83 refs., 68 figs., 26 tabs.

46358 (DOE/PC/70808–T4) **Intercrystalline anion exchange, sorption, and base catalysis: Final project report.** Marcelin, G. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. [1990]. 53p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-84PC70808. Order Number DE90017219. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Double-metal layered hydroxides are compounds similar in structure to the mineral hydrotalcite. They consist of brucite layers $\{Mg(OH)_2\}$ in which a portion of the divalent magnesium has been substituted by a trivalent cation in an octahedral coordination state, such as aluminum. Such substitution results in a mixed-metal hydroxide layer bearing a net positive charge which is balanced by the presence of anions in the interlayer. These materials can be conceptualized as being the anionic analogs of cationic clays (such as montmorillonite). It should be feasible to prepare double metal layered hydroxides with strong basic anions in the interlayer (anions such as OH^-, O^{2-}, or NH_2^-) in order to carry out catalytic processes useful in coal liquefaction. This report outlines work performed dealing with various aspects of HT-like compounds. The synthesis and sorptive properties of double-metal layered hydroxides have been examined, as were the acid-base properties of these layered materials and on the use of the layered materials as precursors of solid bases, and the role of the nature of the cations and the layer composition on the acid-base properties of the resulting mixed-oxide. The decomposition of 2-propanol was used as a model reaction since the products depend on the acid-base character of the catalyst. 24 refs., 12 figs., 3 tabs.

46359 (DOE/PC/88800–25) **Stable carbon isotope analysis of coprocessing materials: Quarterly technical progress report, April 1–June 30, 1989.** Burke, F.P.; Winschel, R.A.; Lancet, M.S. Consolidation Coal Co., Library, PA (USA). Research and Development Dept. May 1990. 91p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88800. Order Number DE90016753. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Consol R&D is developing and demonstrating stable carbon isotope analysis as a method quantitatively distinguish coal-derived and petroleum-derived carbon in products from coal/petroleum coprocessing. The approach taken is to develop the method, then demonstrate its application on authentic continuous-unit products. The significance of selective isotopic fractionation is being determined and, if necessary, corrections will be applied to account for it. Activities for this quarter include: method development – investigation of selective fractionation. Three petroleum atmospheric still bottoms (ASBs) were separated by distillation and solubility fractionation to determine the homogeneity of the carbon isotope ratios of the separated fractions. These same three petroleum ASBs and three geographically distinct coals were pyrolyzed at 800°F for 30 min and hydrogenated over a CoMo catalyst at 750°F for 60 min to determine the effects of these treatments on the isotopic compositions of the produce fractions. Twelve coal liquefaction oils were analyzed for carbon isotope ratios. These oils were derived from subbituminous and bituminous coals from the first- and second-stage reactors in the thermal/catalytic and modes; validation and application, analysis. Carbon isotope analyses of samples from HRI bench unit coprocessing run 238-2 (Taiheiyo coal/Maya VSB) were analyzed. A method to correct for selective isotopic fractionation was developed and applied to the data. Five coprocessing samples were analyzed at the request of SRI International. 12 refs., 15 figs., 24 tabs.

46360 (DOE/PC/88806–T4) **Cooperative research in coal liquefaction infratechnology and generic technology: Final report, May 1, 1988 to April 30, 1989.** Huffman, G.P. (ed.) (Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA)); Sendlein, L.V.A. (ed.). Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 25 Aug 1989. 309p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-88PC88806. Order Number DE90016757. Source: NTIS, PC A14/MF A01 - OSTI; GPO Dep.

Coordinated research on coal liquefaction is described from the following universities: Kentucky, Pittsburgh, West Virginia, Auburn, and Utah. The Kentucky Center for Applied Energy Research also participated. Research areas included: low temperature depolymerization and liquefaction; catalysis research and the coprocessing of coal and petroleum residuum utilizing transition metal carbonyls as catalysts; basic liquefaction research studying chemical reactions during coprocessing and solvent extraction; structural characterization; and bioprocessing. References, figures, and tables are included in each section. (CBS)

46361 (DOE/PC/88915–T7) **Steam gasification of carbon: Catalyst properties: Reporting period, March 15, 1990–June 14, 1990.** Falconer, J.L.; Lauderback, L.L. Colorado Univ., Boulder, CO (USA). 20 Jun 1990. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88915. Order Number DE90015143. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This research uses three techniques to study catalyzed gasification of carbon in an effort to determine the concentration of catalyst sites on a carbon surface and thus determine how effectively a catalyst utilized for steam gasification. Both alkali and alkaline earth oxides are effective catalysts for accelerating the gasification rate of coal chars, but in many cases only a fraction of the catalysts is in a form that is effective for gasification. We will study the steam gasification of carbon in order to determine the concentration of active catalyst sites, the composition of the catalyst, and the location of the catalyst on the surface. Transient isotope tracing (switching reactant feed gases between $H_2{}^{16}O$ and $H_2{}^{16}O$) will be used to measure the concentration of sites at steady-state reaction conditions. A steady flow of $H_2{}^{16}O$ in He will be replaced by $H_2{}^{18}O$ in He, while maintaining the same reaction rate, and the change in product signals will be detected with a computer-controlled mass spectrometer. Secondary ion mass spectrometry (SIMS) will be used for both high surface area samples of carbon/carbonate mixtures that are heated in steam to various temperatures and for model surfaces with deposited ions. SIMS will provide a direct measurement of surface composition. Scanning tunneling microscopy (STM), a technique that provides atomic resolution images of surfaces, will be used to determine catalyst dispersion and the location of catalyst on the surface. The interrelation of the results from these techniques (for potassium and calcium catalysts) will provide knowledge of catalyst dispersion, compositions, and utilization. Such knowledge is needed for optimal use of catalysts in steam gasification of coal char. 27 refs., 9 figs.

46362 (DOE/PC/88917–T5) **A new approach in ultrapurification of coal by selective flocculation: Progress report.** Moudgil, B.M. Florida Univ., Gainesville, FL (USA). Dept. of Materials Science and Engineering. Jun 1990. 14p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88917. Order Number DE90016759. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A relatively pure sample of coal and coal pyrite (free of clays) was provided form the Coal Research Resource Center at VPI, Blacksburgh, VA. The samples have been prepared and single mineral flocculation tests are in progress to confirm the selectivity achieved with the previously evaluated flocculents. The mathematical/computational model was used to predict the effect of process parameters such as feed composition and polymer dosage on the yield and selectivity. It is determined that improvement in selectivity can be achieved by controlling the dosage of not so selective flocculents. Further screening of potential selective flocculents will continue. Also FT-IR and heat of adsorption measurements and planned to better understand the parameters which control the floc properties. 7 figs., 1 tab.

46363 (DOE/PC/88922–7) **Supercritical fluid thermodynamics for coal processing: Quarterly progress report, April 1–June 30, 1990.** van Swol, F. (Illinois Univ., Urbana, IL (USA). Dept. of Chemical Engineering); Eckert, C.A. Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemical Engineering; Illinois Univ., Urbana, IL (USA). Dept. of Chemical Engineering. 1990. 7p.

Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88922. Order Number DE90016752. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In past quarters, we compiled an extensive database of coal model compound solubilities. We are now exploiting this database to refine and test a new equation of state that we have developed. This equation can be used in the design of coal treatment processes. Our equation of state includes both chemical and physical terms. Understanding solute/solute and solute/entrainer interactions is very important in the development of a model for all types of practical SCF systems. We have extended our fluorescence spectroscopy technique to study the entrainer system: naphthalene/triethylamine/CO_2. The normal fluorescence and exciplex formation were recorded for 1×10^{-5} mole fraction naphthalene and three concentrations of triethylamine (0.06 mole %, 0.14 mole %, and 0.27 mole %, corresponding to approximately 0.005 to 0.05 Molar) in supercritical CO_2 at 35°C and 50°C and pressures from 74 to 140 bar. All experiments were sufficiently removed from the scaling region, yet some were within the area believed to exhibit the dramatically increased local densities or charisma. Care was taken to remain within the one phase region. As in previous experiments with pyrene, the results are interpreted in terms of intensity ratios. 2 figs.

46364 (DOE/PC/89904–T15) **Genetic approach to microbial coal desulfurization: Final report, January 1, 1989–August 31, 1990.** Clark, D.P. (Southern Illinois Univ., Carbondale, IL (USA). Dept. of Microbiology). Southern Illinois Univ., Carbondale, IL (USA). Coal Extraction and Utilization Research Center. Jul 1990. 19p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-89PC89904. Order Number DE90016756. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Naturally occurring sulfur bacteria such as Thiobacillus and Sulfolobus can remove inorganic sulfur from coal. We hope to contribute to the development of genetically engineered bacteria which can remove the organic sulfur effectively. A process which used an appropriate mixture of bacteria to remove both types of sulfur from coal should be inexpensive and produce harmless waste products. We are cloning genes from an Escherichia coli mutant with the ability to oxidize thiophene derivatives in order to enhance this ability. We are also cloning plasmid-borne genes from wild dibenzothiophene degrading strains. By putting together the best genes from various organisms we hope to construct an efficient desulfurizing bacterium. 25 refs., 3 figs., 3 tabs.

46365 (DOE/PC/90005–T20) **Liquid phase methanol LaPorte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 8, April 1–June 30, 1989.** Air Products and Chemicals, Inc., Allentown, PA (USA); Chem Systems, Inc., Tarrytown, NY (USA). 18 Jun 1990. 25p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC90005. Order Number DE90016750. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objectives of this program are to implement and test the process improvements identified through the engineering studies of the current program, to demonstrate the capability of long-term catalyst activity maintenance, and to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH") facility. An optional series of runs on the Process Development Unit (PDU) is offered to extend the testing of the process improvements. This quarter: PDU operations were completed in March and the plant is being mothballed. The development of a fundamental reaction rate model on BASF S3-85 catalyst was started. Rate expressions derived from a dual-site Langmuir-Hinshelwood mechanism are being tested using a nonlinear regression technique to find the best fit. Process variable scans on BASF S3-86 catalyst with a simulated Dow gas have been completed. Two runs with a total of 36 data points covering 14 different sets of conditions were investigated. The installation of a 300 cc autoclave in the coal gas clean-up unit has been completed. 6 figs., 4 tabs.

46366 (DOE/PC/90005–T21) **Liquid phase methanol LaPorte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 9, July 1–September 30, 1989.** Brown, D.M. (Air Products and Chemicals, Inc., Allentown, PA (USA)); Frank, M.E. Air Products and Chemicals, Inc., Allentown, PA (USA); Chem Systems, Inc., Tarrytown, NY (USA). 18 Jun 1990. 45p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC90005. Order Number DE90016749. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Contract objectives are to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH") facility. An optional series of runs on the Process Development Unit (PDU) is offered to extend the testing of the process improvements. This quarter a four-parameter, mathematical model based on a dual-site Langmuir-Hinshelwood mechanism was used by PSG Researchers to successfully describe LPMEOH reaction kinetics with BASF S3-85 catalyst. Methanol synthesis catalyst is susceptible to poisoning by trace contaminants (eg. H_2S, COS, iron carbonyl) present in coal-derived synthesis gas. A guard-bed adsorption system developed by PSG Research to treat feed gas to a LPMEOH reactor was successfully tested in the final phase of the Iron Run laboratory program. The first series of coal gas clean-up experiments at the Great Plains Synfuels plant site were completed. Catalyst activity experienced persistent decline. Two scenarios were identified as the most likely reasons for the deactivation. 12 figs., 5 tabs.

46367 (DOE/PC/90005–T22) **Liquid phase methanol LaPorte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 10, October 1–December 31, 1989.** Air Products and Chemicals, Inc., Allentown, PA (USA); Chem Systems, Inc., Tarrytown, NY (USA). 18 Jun 1990. 41p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC90005. Order Number DE90016562. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objectives of this program are to demonstrate the capability of long-term catalyst activity maintenance, and to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH") facility. An optional series of Process Development Unit (PDU) runs is offered to extend the testing of the process improvements. This quarter, the second field test at the Dakota gas Company's (DGC) Great Plains plant was completed after 500 hours on-stream. Catalyst performance was much improved over the first test, approaching that seen in laboratory testing using impurity-free synthesized DGC gas. Data from Field Test II was analyzed in detail. A rate model developed by Process Engineering was used to estimate rate constants. To estimate relative catalyst deactivation for each test, regression was carried out to fit an exponential decay in activity. The new fuel testing program at SWRI was started. LaPorte fuel-grade methanol will be evaluated against a commercial grade M-85 fuel (supplied by BP Oil) in combustion engine applications.

46368 (DOE/PC/90005–T27) **Liquid phase methanol LaPorte process development unit: Modification, operation, and support studies: Quarterly technical progress report No. 11, January 1–March 31, 1990.** Air Products and Chemicals, Inc., Allentown, PA (USA); Chem Systems, Inc., Tarrytown, NY (USA). 19 Jun 1990. 26p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC90005. Order Number DE90016751. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objectives of this program are to implement and test the process improvements identified through the engineering studies of the current program to demonstrate the capability of long-term catalyst activity maintenance, and to perform process and design engineering work that can be applied to a scaled-up Liquid Phase Methanol (LPMEOH) facility. An optional series of PDU runs is offered to extend the testing of the process improvements. This quarter: an implementation strategy for modifications to the LaPorte PDU was issued on 23 February. The strategy proposes phased installation of new equipment. Methanol was tested as an automotive fuel. The test includes startability, Octane Numbers, engine tests, emission analysis, and material compatibility. Existing rate expressions were modified in an attempt to better describe the effect of GHSV on the CH_3OH rate for the S3-86 catalyst. 2 figs., 3 tabs.

46369 (DOE/PC/90909–T10) **Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Final technical report.** Miller, R.L.; Baldwin, R.M. Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum

Refining. Aug 1990. 60p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90909. Order Number DE90017249. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The overall objective of this research was to investigate the feasibility of using homogeneous basic nitrogen compounds such as 1,2,3,4-tetrahydroquinoline to promote coal dissolution and, in turn, improve distillate yields during low severity coal liquefaction. The rational for this project was provided by preliminary observations in our laboratory that nitrogen compound adduction could be reduced by reducing reaction severity. Results from a series of single stage batch reactor screening runs using seven model nitrogen compounds confirmed our preliminary observations that selected compounds could enhance both coal conversion and distillate yield at low severity reaction conditions without significant thermal degradation or incorporation into residual liquefaction products. Dipropylamine and 1,2,3,4-tetrahydroquinoline (THQ) improved Kentucky #9 coal conversion by 53 wt % and 41 wt % (maf basis), respectively, with nitrogen losses of less than 3 wt %. Decreased reaction severity significantly lowered the extent of nitrogen incorporation. Distillate yields under low severity conditions were much lower than high severity yields, but coal conversion were affected to a much lesser extent. The statistical effects of reaction severity, coal rank, solvent type (petroleum or coal-derived), nitrogen compound promotor (THQ or dipropylamine), heterogeneous catalyst addition, and H_2S addition on single stage liquefaction performance were determined. A total of 35 batch reactor experiments were completed. Results are described. 35 refs., 8 figs., 21 tabs.

46370 (EPRI-GS–6971) **Corrosion in syngas coolers of entrained slagging gasifiers.** Perkins, R.A. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Metallurgy Lab.); Marsh, D.L.; Clark, P.R. Electric Power Research Inst., Palo Alto, CA (USA); Lockheed Missiles and Space Co., Palo Alto, CA (USA). Metallurgy Lab. Aug 1990. 148p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

The corrosion of candidate alloys and coatings for syngas coolers is studied in the laboratory prior to testing and use of materials in pilot plants. In many cases, simulated syngas tests in the laboratory have not reproduced adequately the attack that has been observed in pilot plant exposure of the same materials. A study of the process variables that may influence corrosion has been made to determine what modifications of laboratory tests can be introduced to reproduce more accurately the results of plant exposures. Variables that have been evaluated include: (1) cyclic operation, (2) temperature differential between gas and metal surfaces, (3) H_2S partial pressure and total system pressure, (4) applied stress, (5) HCl in syngas, and (6) surface deposits of slag and chlorides. Results indicate that each variable has a significant effect on the behavior of one or more materials that are being considered for use in operating plants. Several variables have a significant effect only when they are coupled together. The relative importance of the test variables is strongly materials dependent. The in-plant behavior of most materials can be reproduced accurately by modification of laboratory tests to include these variables. Testing at atmospheric pressure under isothermal conditions is suitable for screening of materials but fully integrated testing under high pressure syngas with HCl, surface deposits, and a temperature differential between the gas and metal is recommended for an in-depth evaluation of the most promising materials. 23 refs., 71 figs., 16 tabs.

46371 (IS–4970) **Regeneration of alkali in caustic desulfurization systems: Fossil energy quarterly report, April 1, 1988–June 30, 1988.** Markuszewski, R.; Norton, G.A.; Chriswell, C.D. Ames Lab., IA (USA). Sep 1988. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017298. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall objectives of this project is to develop and test feasible reaction pathways for regenerating the spent caustic and acid streams used to remove sulfur and ash from coal in the molten caustic leaching (MCL) process being developed by TRW in California. This quarter, experiments on precipitating double salts using model spent acid solutions indicated that 90% or more of the solids present in the solution could be precipitated at 80°C as natrojarosite and gypsum. The precipitate yield and the removal of iron and sulfate increased dramatically as the pH was increased from 1.1 to about 1.5. Maximum sodium removals of only about 70% were obtained. A spent acid stream obtained from the laboratory simulation of counter-current washing of caustic-treated coal, performed at Ames, was also tested for precipitate formation at 80°C for 6 hours at a pH of 1.5. Initial visual observations indicated that the spent acid behaved similarly to the model solutions. Additional tests on precipitating another double salt, sideronatrite, from model solutions indicated that the precipitation of sideronatrite is probably not a viable option for treating spent acid streams from the MCL Process. Results of other experiments on model solutions containing NaOH, KOH, and carbonate and having compositions similar to those of actual spent caustic streams indicated that liming did not effectively precipitate carbonate. 4 refs., 3 figs.

46372 (IS–4996) **Regeneration of alkali in caustic desulfurization systems: Fossil energy quarterly report, January 1, 1989–March 31, 1989.** Markuszewski, R.; Norton, G.A.; Chriswell, C.D. Ames Lab., IA (USA). May 1989. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017302. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall objective of this project is to develop and test feasible reaction pathways for regenerating the spent caustic and acid streams used to remove sulfur and ash from coal in the molten caustic leaching (MCL) process being developed by TRW. As an integral part of these tasks, modern analytical method are used, or developed if needed, to acquire chemical information pertaining to the regeneration of reagents and to the chemistry and mechanisms of coal cleaning. Another specific objective of the project pursued during this reporting period was an attempt to elucidate the effects of reactor materials on the removal of sulfur from coal samples during MCL. The effects were studied using NaOH alone and NaOH-KOH mixtures as leachants. 10 refs., 3 tabs.

46373 (IS–5013) **Regeneration of alkali in caustic desulfurization systems: Fossil energy quarterly report, April 1, 1989–June 30, 1989.** Markuszewski, R.; Chriswell, C.D.; Norton, G.A. Ames Lab., IA (USA). Jul 1989. 32p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017310. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Studies continued in an attempt to elucidate (1) the effects, if any, of reactor materials (Inconel Alloy) on the desulfurization of coal and (2) the conditions under which humic-like materials form and decompose during molten caustic leaching (MCL) of coal. Additional data from MCL studies continue to suggest that materials from which reactors are formed affect only slightly the desulfurization of coal samples. Essentially no effects of reactor material on the desulfurization of coal samples have been observed when NaOH-KOH mixtures are used as leachants, and only slight differences have been observed when NaOH alone is used as a leachant. The use of an aged Inconel reactor crucible apparently enhances the desulfurization of coal when NaOH alone is used as a leachant. Differences in the temperature of coal-caustic mixtures at different locations within this Inconel reactor have also been measured. A comprehensive study has been completed to determine the conditions under which humic materials form and degrade during cleaning of coal by MCL. The results of these studies show that significant amounts of humic materials form at temperatures above about 200°C and then decompose at temperatures above about 350° to form low-sulfur "regenerated coal". Effects of time, caustic composition, temperature, coal characteristics, and reaction atmospheres on humic formation have been determined. 11 refs., 10 figs., 10 tabs.

46374 (NEDO-P–8907) **Studies on principal factors to improve economics in coal liquefaction process.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 125p. (In Japanese). Order Number DE90517225. Source: NTIS (US Sales Only), PC A06/MF A01.

This study, for the purpose of economicaly improving the coal liquefaction process, studied the process in principal factors and tie up with chemical industries. As for the relation between the coal property and liquefaction reactivity, volatile matter and atomic H/C ratio were known to be highly correlated with the liquefied liquid yield. Contained mineral matter, through demineralization, is improved in both separation and reaction processes, which further

heightens the economicality. Recycle solvent, if added with heavy residual oil, improves in solvent performance. Both ion and molybdenum catalysts were explained in heightening in activity and factors to control lowering in activation to indicate how to develop high activation catalyst. Phenol, cresol, etc., and quinoline, indol, etc. in coal liquefied liquid can be transformed to hydrocarbonic liquid by hydrotreating. Those contents were known to be high as chemicals in additional value and largely influential on lowering in cost for liquefied liquid. 140 refs., 68 figs., 31 tabs.

46375 (PNL-SA-17750) **A search for the radical hydrogen transfer pathway in coal hydroliquefaction.** Autrey, T.; Franz, J. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900402--10: 199. national meeting of the American Ceramic Society, Boston, MA (USA), 22-27 Apr 1990). Order Number DE90016309. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is generally accepted that the formation of petroleum liquids produced in the thermal liquefaction of coal can not be completely explained by simple homolytic cleavage of strong linkages in coal structures. Model compound studies have been employed to elucidate the mechanisms of scission of strong bonds in coal structures and have provided useful information for increasing the efficiency of the coal liquefaction processes. Radical Hydrogen Transfer (RHT), the transfer of a hydrogen atom from a solvent-derived cyclohexadienyl substituted radical to the ipso position of an aryl-alkyl linkage, has been proposed as an important pathway for the cleavage of strong bonds in coal structures during coal liquefaction. Elegant numerical modeling studies of the scission of diarylmethane model compounds in the presence of a variety of solvent molecules demonstrated that an alternative mechanism for the scission of the strong bonds in these model compounds may be operative that involves cyclohexadienyl-derived solvent molecules rather than free hydrogen atoms.

46376 **Polyoxoanions as soluble metal oxide analogues. 6. Catalytic activity and initial kinetic and mechanistic studies of polyoxoanion-supported, atomically dispersed iridium(I), (1,5-COD)Ir x $P_2W_{15}Nb_3O_{62}^{8-}$.** Lyon, D.K. (Univ. of Oregon, Eugene (USA)); Finke, R.G. *Inorganic Chemistry (USA)*, 29(10): 1787-1789 (16 May 1990).

Data are presented that demonstrate that the polyoxoanion-supported Ir(I) precatalyst, $(Bu_4N)_5[(1,5\text{-}COD)Ir \times P_2W_{15}Nb_3O_{62}]$ (I) leads to an active and long-lived catalyst in a phototypical catalytic reaction, olefin hydrogenation. Initial kinetic and mechanistic data are also reported that provide evidence that the actual catalyst derived from I is indeed polyoxoanion supported. 14 refs., 1 fig.

0105 Products and By-Products

Refer also to citation(s) 46581

0106 Properties and Composition

Refer also to citation(s) 46336, 46338, 46340, 46346, 46348, 46349, 46352, 46353, 46360, 46397, 46401, 47279

46377 (DOE/PC/88926-T3) **Gaseous phase surface modification of coal: [Quarterly progress report], December 1989-February 1990.** Pinion, J.; Okoh, J.M. Maryland Univ., College Park, MD (USA). [1990]. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88926. Order Number DE90016761. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The enhancement of the surface hydrophobicity of coal is essential in coal cleaning processes such as froth flotation or selective agglomeration. Friedel-Crafts reaction results in the formation of alkyl groups on the coal surface. Using various chemical reagents (alkenes, alcohols and catalyst) the surface hydrophobicity of the coal was enhanced. Comparative surface studies using treated and untreated coal showed as increase in the contact angle of untreated coal form 41° originally to 74° after treatment. The effects of the chemical treatment on the coal surface was subsequently confirmed in flotation tests. Using Illinois #6 coal, floatability was increased from 28.91% to 72.15% in 18 seconds, while the work of adhesion was decreased from 91.80 to 71.97 Joule/m^2. Enhanced hydrophobicity is correlated with the degree of coal surface alkylation. 7 figs.

46378 (DOE/PC/88926-T5) **Gaseous phase surface modification of coal: [Quarterly report], September 1989-November 1989.** Pinion, J.; Okoh, J.M. Maryland Univ., College Park, MD (USA). [1990]. 27p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88926. Order Number DE90016763. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

FT-infrared spectra of coal are presented after alkylation, grinding, and ethylene treatments. Differences in the spectra are briefly discussed. 23 figs. (CBS)

46379 (DOE/PC/88934-T6) **Enhancement of surface properties for coal beneficiation: Technical progress report, April 1, 1990-June 30, 1990.** Chander, S.; Aplan, F.F. Pennsylvania State Univ., University Park, PA (USA). [1990]. 4p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88934. Order Number DE90016797. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The main objective of this research project is to study ways to modify surface properties of coal, pyrite and ash-forming mineral matter for beneficiation of fine coal. Since the differences in surface properties of coal and mineral matter are utilized in several oil based preparation technologies, such as: froth flotation, emulsion flotation, spherical agglomeration and liquid-liquid separation, another objective is to delineate the role of oil. The following studies are being carried out to achieve the objectives states in the previous paragraph: investigation of the natural hydrophobicity of coal and pyrite; development and evaluation of enhanced coal hydrophobicity; development and evaluation of reagents which modulate the hydrophobicity of pyrite; and development and evaluation of emulsion processes and their underlying principles.

46380 (DOE/PC/88939-9) **Methane formation and retention in coal: Quarterly technical progress report, April 1, 1990-June 30, 1990.** Hucka, V.J. Utah Univ., Salt Lake City, UT (USA). Dept. of Mining Engineering. [1990]. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88939. Order Number DE90016793. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The methane content of coal seams in Utah and Colorado will be measured in situ as well as in the laboratory and correlated with geological and geochemical history of the seams and surrounding strata. Chemical and physical properties will be measured in the laboratory for coals that contain methane and coals of similar rank which do not contain methane. Methane yields on pyrolysis will be used to measure the propensity of coals on similar rank which do not contain methane. Methane yields on pyrolysis will be used to measure the propensity of coals to form additional methane. Methane formation and retention will be interpreted in terms of the physical and chemical properties of the coal and the chemical and geological history of the coal seam. 11 figs.

46381 (INT-232/I) **Determination of moisture content in hard coals using microwave meter.** Chrusciel, E.; Kopec, M.; Turek, B. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1989. 11p. Order Number DE90640132. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The results of hard-coal moisture-content measurements, performed with the aid of the ZAM-WILMER microwave meter are presented. Over 80 ground coal samples, weighing 1.5 kg (approx.) each, were examined. The moisture content values ranged from 0 to 15 wt%, with the mean standard error being equal to 0.8 wt%. 5 refs., 2 figs., 1 tab. (author).

46382 (IS-5000) **Advanced spectroscopic analysis of coal surfaces during beneficiation: Fossil energy quarterly report, January 1, 1989-March 31, 1989.** McClelland, J.F.; Oh, J.S. Ames Lab., IA (USA). May 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017305. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two new analytical methods continued to be developed for infrared analysis of coal. The first was ultraviolet-induced oxidation with FTIR spectroscopy to gauge the concentration of unoxidized species in the surface region of coal. The FTIR/UV technique was

explored in three key areas: surface layer specificity, application to coals of varying rank, and the problem of fresh coal reference material. The second new method called Transient Infrared Emission Spectroscopy (TIRES) uses laser excited transient heating to generate infrared emission from coal in motion for on-line analyses. The use of pulsed rather than CW laser excitation was studied and found to be less desirable for coal stream analysis than CW laser excitation. 4 figs.

46383 (IS–5004) **Functional group analysis in coal and on coal surfaces by NMR [nuclear magnetic resonance] spectroscopy: Fossil energy quarterly report, April 1, 1989–June 30, 1989.** Verkade, J.G. Ames Lab., IA (USA). Jun 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017306. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this research is to develop a convenient, sensitive, reliable and rapid technique for the determination of the labile-hydrogen functional group composition of coal and coal-derived materials by the NMR spectroscopy of their derivatives made with regents containing the NMR-active nuclei ^{31}P, ^{113}Sn, or ^{205}Tl. Knowledge of the heteroatom composition of coals is necessary to the development of increasingly sophisticated coal processing technologies. This quarter, the moisture content of several coals was determined. 18 refs., 2 tabs.

46384 (IS–5007) **Advanced spectroscopic analysis of coal surfaces during beneficiation: Fossil energy quarterly report, April 1, 1989–June 30, 1989.** McClelland, J.F.; Oh, J.S. Ames Lab., IA (USA). Jun 1989. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-82. Order Number DE90017309. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress is reported in verifying the surface specificity of the FTIR/UV method for measuring coal surface oxidation by comparing spectra taken at shallow and deep-sensing penetration. The surface versus bulk distribution of OH species associated with moisture changes in coal during oxidation were explored by varying the sensing depth of measurements and with an in situ heated-sample-cup drying system. The presence of coal surface oxidation was found to be absent in the Ozone treatment process used previously for enhanced beneficiation by flotation, suggesting that some mechanism other than oxidation may be important. In a companion study, photoacoustic FTIR spectroscopy was found to have some advantage over diffuse reflectance spectroscopy of coal surface oxidation due to better repeatability and higher surface-specificity. 1 ref., 8 figs.

46385 Comparison of batch and continuous flow particle sizing of pulverized coal. Mescher, A. (Dept. Mechanical Engineering, Ohio State Univ., Columbus, OH (US)); Defazio, M.; Geiger, S.; Essenhigh, R.H. pp. 365-370 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper presents a comparison of particle size distributions (PSD) of pulverized coal measured with a batch sizing analyzer (L and N Mictotrac II) and an on-line continuous flow analyzer (Insitec PCSV-E). Both are laser instruments using analysis of forward scattering to determine the PSD. The coal samples used for the comparisons included both full distributions and sieve cuts. The eventual target of this work is the measurement of PSD's in PC flames, and the purpose of these experiments is to determine the operational characteristics and relative performance of the two instruments by analyzing particles outside the hostile conditions of a flame.

46386 A theoretical study of heat transfer to flowing granular materials. Massoudi, M. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, Pittsburgh, PA (US)); Mathur, M.; Lee, K.Y. pp. 339-344 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

The authors overview research efforts concerned with the mechanics of flowing granular material and their flow characteristics. They present a theoretical study of heat transfer to flowing granular materials.

0108 Waste Management

Refer also to citation(s) 46393, 46401, 46412, 46413, 46414, 46415, 46416, 46417, 46418, 46419, 46420, 46421, 46422, 46427, 46430, 46431, 46432, 46433, 46434, 46440, 46441, 46820, 46821

46387 (DOE/MC/10637–2803, pp. 16, Paper 1) **SO_x/NO_x control.** Weber, G.F. (Univ. of North Dakota, Grand Forks (USA)); Laudal, D.L. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The PETC (Pittsburgh Energy Technology Center) Combined SO_x/NO_x Control Program, initiated as part of the Flue Gas Cleanup program, has emphasized the development of novel approaches to SO_x/NO_x control. The objective of the program is to develop a combined SO_x/NO_x flue gas cleanup technology through the proof-of-concept stage by October 1992, at which time the technology should be ready for private-sector commercialization. The technology must be capable of reducing both SO_2 and NO_x by 90% at a levelized cost at least 20% less than the costs associated with conventional limestone scrubbing and selective catalytic reduction (SCR). Process by-products must be salable or classified as nonhazardous waste suitable for landfill disposal. During the last seven years, Owens Corning Fiberglas Corporation (OCF) has undertaken an extensive research effort to develop a novel catalytic fabric to be used in filter bags for particulate and NO_x control. While initial in-house testing, and testing at the Energy and Mineral Research Center (EMRC) were promising, more research is needed to further develop the product with the best combination of high NO_x removal, low ammonia slip, high particulate removal efficiency, and long bag life.

46388 (DOE/MC/10637–2803, pp. 21, Paper 2) **Waste management.** Moretti, C.J. (Univ. of North Dakota, Grand Forks (USA)); Henke, K.R. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

Waste Management Project personnel are conducting research to characterize waste materials from advanced coal utilization processes and to develop innovative management practices for coal utilization waste disposal. The purpose of the waste characterization work is to predict the environmental impacts of wastes from several processes being developed at the University of North Dakota Energy and Mineral Research Center (UNDEMRC). The project is currently evaluating the chemical and physical properties of wastes from a pressure-hydrated lime injection process designed to reduce SO_2 emissions and from a coal slurry-fired diesel engine. Project personnel are also developing methods for constructing fly ash liners at waste disposal sites. The purpose of the liner study is to assist utility companies to implement new environmental regulations in a cost-effective manner. This paper discusses the results of performance field tests in Indiana, Minnesota, and Texas.

46389 (KTM/E-D–182) **Desulphurization wastes from coal-fired power plants - Amount, quality and utilization in Finland.** Ranta, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Polttoainetekniikan Lab.); Wahlstroem, M.; Lindroos, P.; Haekkinen, T. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. Feb 1990. 110p. (In Finnish). Project KTM-8/881/86. Order Number DE90518695. Source: NTIS (US Sales Only), PC A06/MF A01.

Amounts, quality and utilization of desulphurization wastes from Finland's coal-fired power plants were surveyed. Should the consumption of coal increase as expected (by 6-8 Mt/a), the amount of desulphurization wastes would be 0.8-1.1 Mt/a, and 0.6-1.0 Mt/a of ash would be produced. Possible environmental impacts due to the dumping of desulphurization wastes were investigated for different mixtures of the product of the wet-dry method and fly ash, and for products of fluidized-bed reactors (limestone injection). Soluble

metals and salts were determined with shaking and column tests. Fly ash, moraine and cly and concrete products were used as reference materials. The effect of the binding of materials on the dissolution of metals was, in particular, studied. Water permeabilities were also measured. Of the heavy metals studied, only molybdenum and chromium dissolved more from the desulphurization wastes than from the reference materials. The dissolubility of heavy metals was reduced by binding and consolidation during storage. The dissolution of salts was stable even on a long term. Concrete-technical properties (primarily setting, strenght development and microstructure) and utilization alternatives (cement-bound gravel and roller-compacted concrete) were determined for the products of the wet-dry method, fluidized bed reactor and injection technique. The setting properties were found to be moderate or good, and hence desulphurization wastes can also be used as setting agents. Especially the products of the fluidized-bed reactor and injection technique are well suited for the manufacture of compacted pavement stones and for the production of soil and roller-compacted concrete.

46390 Photoacoustic absorption spectroscopy for detection of unburned carbon in exhaust gas of coal-fired combustors. Dona, A. (Dept. of Mechanical Engineering, Iowa State Univ., Ames, IA (US)); Brown, R.C. pp. 189-194 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses knowledge of the carbon content of fly ash important for calculating combustion efficiency in coal-fired boilers. The authors investigate photoacoustic absorption spectroscopy (PAS) as a method for on-line monitoring of carbon in fly ash. Experiments have been performed on fly ash samples of variable carbon content suspended in a gas flow. A 35-mW HeNe laser was able to detect carbon loadings of 0.75 g/m3. Order of magnitude improvements in detection sensitivity are expected with higher power lasers or improved PAS cell design.

46391 A model for the simulation of complex chemical kinetics in a turbulent jet, with application to the removal of NO_x. Dibble, R.W. (Combustion Research Facility, Sandia National Lab., Livermore, CA (US)); Broadwell, J.E.; Lutz, A.E.; Kee, R.J. pp. 141-146 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses injecting a jet of ammonia and air into a combustion product stream to remove NO. A model for chemically-reacting turbulent flows is presented. The authors' expectations are offered.

0109 Environmental Aspects

Refer also to citation(s) 46339, 46916, 47513, 47514, 47517, 47599, 47600

46392 (GAO/T-RCED–90-56) **Utilities' potential use of clean coal technologies.** Rezendes, V.S. General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 14p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

Emerging clean coal technologies could help significantly reduce emissions from coal-fired power plants. However, it is uncertain whether this technology will be commercially available and widely deployed in time to meet the requirements of proposed acid rain legislation. Although utilities said they would give much greater consideration to these technologies once legislation is enacted, they indicated that their investment decisions would also depend on factors like technical feasibility, cost effectiveness, and emission control capability. Because of anticipated time frames needed for demonstration and deployment, this report concludes that emerging clean coal technologies may play only a limited role in reducing acid rain during the next 15 years.

46393 (PB–90-240615/XAB) **Behavior of dissolved Al, Cu, Be, and Cr during simulated dilution of iron-rich coal leachates with alkaline surface waters. Final report.** Valette-Silver, N.J.; Helz, G.R. Maryland Univ., College Park, MD (USA). Dept. of Chemistry and Biochemistry. May 1990. 44p. Source: NTIS, PC A03/MF A01.

Coal leachates are highly enriched in toxic metals, there is a need to know how the metals behave during dispersion of leachates into natural fresh or estuarine surface waters. In the present work, the authors address the need with two types of experiments. In one type, a synthetic leachate is mixed with NaHCO3 solutions in various proportions. In a modification of this type of experiment, naturally occurring organic extracts are added. In the second type of experiment, the same synthetic leachate is mixed with a natural river water sample and a natural estuarine water sample. The principal goal of these experiments is to determine how efficient ferric hydroxide precipitation is in removing the trace metals during dilution of the leachate. Although the study was designed to investigate the possibility of pollution problems associated with coal storage at power plants, the results should also be applicable to problems associated with acid mine drainage. At the present time, Maryland power plants collect and treat their coal pile runoff.

46394 (PB–90-240805/XAB) **Method development and evaluation of draft protocol for measurement of condensible particulate emissions. Test report.** DeWees, W.G.; Steinsberger, K.C. Entropy Environmentalists, Inc., Research Triangle Park, NC (USA). 16 May 1990. 59p. Contract EPA-68-D90055. Source: NTIS, PC A04/MF A01.

The report describes the development and evaluation of a draft protocol for measuring condensible particulate matter (CPM) emissions. An impinger catch approach was evaluated in the laboratory and at wood-fired and coal-fired boilers. The report summarizes the approach and major findings and recommendations which resulted from the study. Test results and statistical analysis of the results are presented.

46395 (SERI/SP–231-3579, pp. 9-15) **Microalgal mass culture and the greenhouse effect: Resources update.** Chelf, P. (Solar Energy Research Institute, Golden, CO (USA)); Brown, L.M. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

The purpose of this article is to review the resource requirements for algal mass culture, to discuss the feasibility of this technology for fuel production, and to examine the use of microalgae as a biological sink for carbon dioxide released from the burning of fossil fuels. Resource assessments have demonstrated that sufficient land and water for mocroalgal farms exists in a number of locations in the desert southwest. Technology assessments have demonstrated the long-term potential of fuels from microalgae, and have identified specific goals to make this technology economically feasible. We have utilized the existing data regarding availability of saline groundwater in Arizona and New Mexico, land and climate suitability is these states, and location, size, and carbon dioxide emissions from power plants in the area to assess the impact that microalgal energy farms could have on carbon dioxide emissions in these two states.

46396 Geochemical factors controlling the mobilization of inorganic constituents from fossil fuel combustion residues. II. Review of the minor elements. Eary, L.E. (Pacific Northwest Laboratories, Richland, WA (USA). Environmental Science Dept.); Rai, D.; Mattigod, S.V.; Ainsworth, C.C. *Journal of Environmental Quality (USA),* 19(2): 202-214 (Apr-Jun 1990).

Past studies of the environmental aspects of fossil fuel waste disposal have focused on determining elemental concentrations, elemental distributions, and empirical rates of elemental extraction. The concentration data for the minor elements (i.e., As, B, Ba, Cd, Cr, Cu, Pb, Mn, Hg, Mo, Ni, Se, Sr, V, and Zn) are extremely variable and dependent on fuel composition and combustion processes. Studies of elemental extraction rates have provided empirical information on short-term leaching behaviour relevant only to a specific waste sample. Extraction studies serve to characterize the initial states of wastes prior to disposal but generally have not provided information on the dominant weathering reactions that

control the long-term concentrations of minor elements in the disposal environment. It is proposed that a more useful approach for understanding leachate chemistry involves consideration of the thermodynamics of specific dissolution/precipitation, adsorption/desorption, and redox speciation reactions that occur during weathering in addition to empirical data. Because fossil fuel wastes are composed of high-temperature solids formed under conditions of combustion, this approach can be used to describe the reaction paths governing the alteration of the high-temperature solids to assemblages of secondary solids and aqueous species stable in weathering environments. The depiction of leaching behaviour through solubility and speciation relationships rather than through empirical interpretations of extraction rates allows one to establish bounds for the aqueous concentrations of various elements, given information on the chemistry of waste solids and on physical and chemical conditions. The determination of thermodynamic data and application of those data to understanding the leachate chemistry of the minor elements in the disposal environment remains an area where much research is needed. 104 refs., 4 figs., 6 tabs.

0110 Reserves, Geology, and Exploration

Refer also to citation(s) 46621

0120 Mining

Refer also to citation(s) 46380, 46622

0130 Transport, Handling, and Storage

46397 (DOE/PC/88949–T7) **Advanced study in solid transport: Rheological behavior of dense suspension: Seventh quarterly report, April 1–June 30, 1990.** Roidt, R.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center); Burgman, H.A.; Kim, H.J.; Chen, J.L.S. Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center. 2 Jul 1990. 32p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88949. Order Number DE90016795. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this program is to develop a basic understanding of the fundamental rheological properties of high solids concentration (50% to 100%) slurries and wet cake. This quarter models were developed to describe the effects of cell wall friction and glass beads on the actual normal load, to represent hear stress as a function of water saturation and normal stress, and shear tests were performed on Illinois No. 6 coal powder. 5 refs., 2 figs., 3 tabs. (CBS)

0140 Combustion

Refer also to citation(s) 46338, 46818, 47112

46398 (ANL/ESD/TM–4) **Time-averaged and instantaneous porosity distribution in a fluidized bed with an immersed obstacle.** Lyczkowski, R.W.; Bouillard, J.X.; Gidaspow, D.; Berry, G.F. Argonne National Lab., IL (USA). Energy Systems Div. Feb 1990. 45p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE90016663. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Erosion in bubbling fluidized-bed combustors is a serious issue that may affect their reliability and economics. Available evidence suggests that the key to understanding this erosion is detailed knowledge of the coupled and complex phenomena of solids circulation and bubble motion. A thin, transparent "two-dimensional" rectangular fluidized bed with an obstacle served as a rough model for a fluidized-bed combustor. This model was studied experimentally and computationally, using two hydrodynamic equation sets. The computed hydrodynamic results agree reasonably well with experimental data. Bubble frequencies and sizes compare well with those obtained from analyzing a high speed motion picture frame-by-frame. Time-averaged porosities computed from both models agree with time-averaged porosity distributions measured with a gamma-ray densitometer. The principal differences between the data and the computations in this paper result from asymmetries present in the experiment and from the simplified solids rheology used in the hydrodynamic models. 53 refs., 26 figs., 7 tabs.

46399 (CONF-890402–10) **Studies on coal devolatilization and char reactivity under PFBC [pressurized fluidized-bed combustion] conditions.** Shiao, Shih-Yung; Warchol, J.J.; Perna, M.A.; Chandran, R.R. Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. [1989]. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23247. From 10. international conference on fluidized-bed combustion; San Francisco, CA (USA); 30 Apr - 3 may 1989. Order Number DE90015981. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this study is to obtain fundamental combustion data on coal devolatilization and char reactivity under pressurized fluidized-bed combustion (PFBC) conditions using a bench-scale PFBC reactor. The combustion tests will be performed under various pressures, temperatures, coal particle sizes, oxygen concentrations, and gas velocities. 8 refs., 6 figs., 5 tabs.

46400 (DOE/MC/10637–2803, pp. 27, Paper 3) **Turbine combustion phenomena.** Swanson, M.L. (Univ. of North Dakota, Grand Forks (USA)); Mann, M.D. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall objective of the Turbine Combustion Phenomena Program is to expand the scientific and engineering data base for the combustion of low-rank coal (LRC) fuels in advanced pressurized combustion systems such as those found in gas turbine engine applications. Fundamental research on the use of low-rank coal slurries for gas turbine engine applications will develop data that will (1) quantify the potential advantages of low-rank coal's higher reactivity and non-agglomerating tendency; (2) help in determining fuel specifications; and (3) indicate needed design modifications in the gas turbine engines themselves. Research will be directed toward understanding the effects of low-rank coal (LRC) and slurry properties (including ash level and composition, moisture levels, and slurry rheology) on the combustion efficiency, vaporization and deposition of inorganics, and erosion of materials in pressurized combustion systems. The intent of this research is to establish the relationships between LRC properties and gas turbine engine operational parameters, and to compare these relationships with those established for diesel fuel and bituminous coal slurries. The investigation of turbine combustion phenomena at UNDEMRC is a multiyear program. Three-year goals have been established and are discussed in the following text.

46401 (DOE/MC/10637–2803, pp. 42, Paper 4) **Combustion inorganic transformations.** Benson, S.A. (Univ. of North Dakota, Grand Forks (USA)); Sweeny, P.G.; Abrahamson, H.B.; Puffe, W.H.; Zygarlicke, C.J.; Steadman, E.N.; Mills, M.E. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall goal is to develop a unified picture of the physical and chemical changes that occur in coal inorganic matter during combustion. The research is centered on two main tasks. Task 3.2A deals with the use of laser-induced fluorescence spectroscopy (LIFS) to study the release of sodium from various model compounds and coal during combustion in a flame. Task 3.2B will study changes in the morphology and chemical associations of inorganic components in coals during combustion in a drop-tube furnace designed to simulate the time-temperature profile of a pulverized coal-fired utility boiler. The primary objectives of the drop-tube furnace task are to develop a means to predict the size and composition of the fly ash and to provide adequate information for development of ash deposition modeling efforts to effectively predict deposit growth. The important information with regard to ash deposition is the distribution of inorganic gases, liquids, and solids (intermediate material) as functions of residence time and temperature in a combustor. The composition of the ash particles is needed to predict the quantity of liquid phase present. In the initial stages of deposit growth (via the inertial impaction transport mechanism), the ability to a particle to stick is depend upon the

quantity and physical properties (viscosity and surface tension) of the liquid phase on and within the particle. The latter stages of deposit growth due to inertial impaction is primarily governed by the quantity of liquid phase present at the surface of the deposit.

46402 (DOE/MC/10637–2803, pp. 40, Paper 5) **Coal/char reactivity.** McCollor, D.P. (Univ. of North Dakota, Grand Forks (USA)); Sweeny, P.G.; Benson, S.A. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall objective of the coal/char reactivity project is to expand the fundamental combustion data base to support existing and advanced atmospheric combustion systems. The investigations will focus primarily on elucidating the burning rates of chars under realistic flame conditions as a function of fuel and system parameters. The chars are mainly derived from low-rank coals. The key issues include the relative contributions of inorganic constituents, and the surface and structural effects on the burning behavior of the low-rank coal-derived chars. Test will be undertaken to ascertain the limits of bulk diffusion control of the burning rate. The specific objective for this reporting period was to evaluate the burning rates obtained and to determine rate constants based on CO, CO_2, and CO/CO_2 as primary reaction products. A second objective was to perform fundamental investigations on the ignition mechanisms of single particles of low-rank coals by measuring rates of carbon monoxide and carbon dioxide production. The specific objectives of this quarter were to determine: (1) the effects of oxygen concentration on the ignition and combustion of Beulah lignite (PSOC-1507), and (2) the effects of calcium on the ignition and combustion of Beulah lignite (PSOC-1507).

46403 (DOE/MC/10637–2803, pp. 8, Paper 8) **Fluidized bed combustion of low-rank coals.** Mann, M.D. (Univ. of North Dakota, Grand Forks (USA)). North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall objectives of the low-rank coal (LRC) fluidized bed combustion(FBC) program at the University of North Dakota Energy and Mineral Research Center is to conduct research and development programs aimed at providing a technology data base so that industry can bring economically competitive and environmentally acceptable coal technology options into the marketplace. Research will address those areas where data gaps exist in fuel flexibility and performance, potential operating problems, environmental compliance, and coal-water slurry applications. The focus is on the development of an atmospheric fluidized bed combustion (AFBC) system utilizing low-rank coal for the industrial, commercial, and residential sectors capable of economically meeting process steam and heating requirements.

46404 (DOE/MC/10637–2803, pp. 17, Paper 10) **Low-rank coal slurry combustion.** Gunderson, J.R. (Univ. of North Dakota, Grand Forks (USA)); Johnson, M.D.; Mann, M.D. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The purpose of the slurry combustion project is to expand the scientific and engineering data base on combustion of advanced low-rank coal (LRC) fuel types for residential, commercial, and moderate industrial processes by investigations into the operational and environmental effects of burning slurry fuels made with LRC. To achieve this goal, planned three-year objectives include: design of an LRC/water combustion system with future applications in the residential, commercial, or moderate industrial sectors; investigation of effects of LRC fuel type on slurry combustion characteristics such as ignition limits and flame stability, and on operational problems such as fouling and slagging; production of selected LRC fuels for off-site testing in industrial-scale boilers. Combustion runs would be performed with slurry produced by UNDEMRC's hot-water-drying process. Specific goals for the third year are: (1) Evaluate and optimize the stationary packed-bed slurry combustor built during FY87. The combustion and operational characteristics to be evaluated include ignition limits; start-up and response time; CO, particulate, and hydrocarbon emissions; combustion and steady-state efficiencies; and heat transfer characteristics. (2) Construct the rotating packed-bed slurry combustor designed in FY87 and begin evaluation testing, focusing on combustion characteristics and operational problems. (3) Finalize the design and construct a combustion system to be used in the combustion characterization of dry, ultra-fine, low-rank coal.

46405 (DOE/METC–89/6108-Vol.2, pp. 361-370) **Kinetic behavior of solid particles in fluidized beds.** Kono, H.O. (West Virginia Univ., Morgantown (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Kinetic forces on solid particles in fluidized-bed reactors affect system performance in several critical ways. The objective of this project is to develop and use a technique to measure these forces. Analysis and modeling will provide insight into solid particle performance in fluidized beds. 17 refs., 7 figs.

46406 (DOE/METC–89/6108-Vol.2, pp. 371-376) **Scale models of a fluidized bed combustor; simplification of the scaling laws over all flow regimes from bubbling to circulating flow and the scaling of heat transfer.** Roth, K.W. (MIT Heat Transfer Lab., Cambridge (USA)); Glicksman, L.R. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

It has been shown that the hydrodynamics of a hot fluidized bed combustor can be duplicated by a properly scale bed fluidized by air at room temperature. Experimental confirmation has been obtained for a bubbling bed combustor. Furthermore, companion work at the M.I.T. Heat Transfer Lab. also suggests that the scaling laws hold for circulating fluidized beds. Westphalen's study compares time-resolved pressure measurements at several vertical positions of a scaled bed (2 inch diameter) with the corresponding pressure measurements from a full-scale fluidized bed at the University of British Columbia. The pressure data exhibit a very strong agreement except at the highest (vertically) placed pressure tap. It is hypothesized that this discrepancy may be due to particle-particle interactions occurring at the top of the bed that are not accounted for in the present scaling criteria. The cold scale model has proved useful in fundamental studies of tube erosion, heat transfer, and fundamental studies of the flow phenomena which control the observed properties. 2 refs., 2 tabs.

46407 (DOE/METC–89/6108-Vol.2, pp. 377-378) **Particle motion at fluidized bed tube surfaces.** Drennen, J.F. (Combustion Engineering, Inc., Windsor, CT (USA)); Howard, D.H. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Metal loss from in-bed heat transfer tube surfaces in fluidized bed combustors is affecting the commercialization of BFB technology for coal utilization. The tube wastage mechanism has not been definitely identified and this program was designed to address the erosion aspects. This project is part of a larger FBC tube wastage program supported by DOE/METC. The METC program, which includes analysis, modeling, and experiments, investigates fluidized bed hydrodynamics, erosion phenomena, thermal and chemical effects, and combined mechanisms of erosion and corrosion. The purpose of the project described here was to collect data for use in

other DOE/METC supported projects, that could be used to validate hydrodynamic code predictions, and to verify inputs to erosion codes. The three objectives of the Particle Motion project were: (1) Develop a method for measuring individual particle motion at tube surfaces in fluidized beds. (2) Make these measurements in a fluidized bed test facility at ambient temperature and pressure. (3) Correlate erosion data to particle motion data obtained from the fluidized bed test facility. A probe capable of obtaining the three orthogonal velocity components and mass flux of impacting bed particles was successfully developed during this program. Velocities were measured with a Laser Doppler Anemometer (LDA) and mass flux was obtained from the output of a high speed force transducer. The instrumentation was installed in a 2 inch schedule 40 pipe that simulated an in-bed tube; therefore, the measurements were made non-intrusively. Erosion data was obtained from acrylic tubes during six program tests that ran for over 100 hours each. All tests were done at minimum fluidization in a 0.3 m x 0.6 m test facility utilizing a nominal 1 mm sand bed. Single 15-25 cm bubbles were generated from a separate air source fed into the facility above the distributor plate. 2 refs.

46408 (DOE/METC–89/6108-Vol.2, pp. 379-398) **AR & TD Instrumentation fluidization research.** Fasching, G.E.; Smith, N.S. Jr. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this project is to develop unique sensors, instrumentation systems, and measuring techniques to obtain quantitative descriptions of fluidization phenomena such as bed voidage, particle motion, and particle impact forces. The resulting systems will provide researchers new tools for exploratory and developmental work in fluidization. 5 refs., 11 figs.

46409 (DOE/METC–89/6108-Vol.2, pp. 399-407) **Collaborative research on fluidization employing computer-aided particle tracking.** Chen, M.M. (Univ. of Illinois, Urbana-Champaign (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The primary purpose of this project is to carry out collaborative research on fluidization by constructing a portable radioactive particle tracking apparatus to be used at DOE-Morgantown Energy Technology Center, and then perform measurements and data interpretation on fluidized beds in conjunction with METC personnel. The basic principle of such an apparatus had been developed previously at UIUC, though new measurement technology is employed in the present project to obtain improved accuracy, resolution, and flexibility. In brief, the apparatus makes use of radioactive tracer particle dynamically identical to the bed particles under study. Measurements of gamma photon count rate, computed with an on-line computer, determine the tracer position as a function of time. The information is then stored in disk. When recalled, the data are processed with other software to yield a wide variety of useful information, including the velocity distribution, the velocity fluctuations, the particulate dynamic stresses, and the integral time scales, related to the diffusivity. 5 refs., 4 figs.

46410 (DOE/METC–89/6108-Vol.2, pp. 408-421) **Studies on coal devolatilization and char reactivity under PFBC conditions.** Shiao, S.Y. (Babcock & Wilcox, Alliance, OH (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this study is to obtain fundamental combustion data on coal devolatilization and char oxidation of coals under pressurized fluidized-bed combustion (PFBC) conditions using a bench-scale PFBC reactor. In particular, the project objectives are: Determine the effect of pressure, temperature, coal particle size, gas velocity, and oxygen concentration - typical of full-scale PFBC units - on devolatilization and char oxidation of bituminous and lignite coal. Develop a kinetic model to simulate coal combustion under PFBC conditions. Fit test data to the model and derive devolatilization and char oxidation rate constants and activation energies. 5 refs., 10 figs.

46411 (DOE/METC–89/6108-Vol.2, pp. 422-431) **Improved load turndown using a two-bed fluidized combustor.** Brown, R.C. (Iowa State Univ., Ames (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this research is to investigate a new concept in fluidized bed design that improves load turndown capability. This improvement is accomplished by independently controlling heat transfer and combustion in the combustor. The goal of this research is to develop a fluidized bed combustor with turndown ratio exceeding ten. 10 refs., 5 figs., 2 tabs.

46412 (DOE/METC–89/6108-Vol.2, pp. 435-438) **Thermal/chemical degradation of ceramic candle filter materials.** Sawyer, J. (Acurex Corp., Mountain View, CA (USA)); Brown, J.J.; Brown, N. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this work is to investigate the chemical and thermal degradation mechanisms of ceramic candle filters and to determine the variation of degradation mechanisms with the filter application. 1 ref.

46413 (DOE/METC–89/6108-Vol.2, pp. 439-445) **Cordierite silicon nitride filters.** Sawyer, J. (Acurex Corp., Mountain View, CA (USA)); Buchan, B. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this project is to develop crossflow filters composed of Cordierite Silicon Nitride (CSN). CSN is a material that has shown promise for the manufacture of high-strength porous ceramic material suitable for ceramic crossflow filters. Filter material development will focus on overcoming the corrosivity, strength, and thermal stability problems observed with crossflow filters currently available. The proposed silicon nitride crossflow filter will be designed to provide performance equal to the currently available crossflow filters while providing increased lifetime and strength. 1 ref., 2 figs., 2 tabs.

46414 (DOE/METC–89/6108-Vol.2, pp. 446-452) **A mechanical analysis of a ceramic cross flow filter.** Bachovchin, D.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA)); Smeltzer, E.E.; Kleiner, R.N. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In

Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2. Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this work is to improve the reliability, uniformity, and mechanical integrity of the cross flow filter through improved design and manufacturing. The goal is to provide a cross flow filter that will endure the mechanical and thermal loads and stresses imposed during mounting, startup, operation at HTHP and pulse cleaning. 2 refs., 1 fig., 2 tabs.

46415 (DOE/METC–89/6108-Vol.2, pp. 453-462) **Thermal/chemical degradation of ceramic cross-flow filter material.** Alvin, M.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA)); Lane, J.E.; Tressler, R.E.; Jakus, K. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of Phase I is to identify potential thermal and/or chemical degradation mechanisms that may occur in ceramic cross-flow filter materials during long-term operation at high temperature [538 to 1370°C (1000 to 2500°F)] in coal gasification or combustion environments. Phase II will assess the influence of these degradation mechanisms on filter operating performance and life. 1 ref., 2 figs., 2 tabs.

46416 (DOE/METC–89/6108-Vol.2, pp. 463-468) **Low cost filter development and control of permeability in high temperature, high pressure ceramic filter elements.** Ferri, J.L. (GTE Products Corp., Towanda, PA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Previously crossflow filters have been shown to offer a high filtration area (ten square feet) in a small overall volume. To date crossflow filter units have not had a combination of both high permeability and durability. Durability problems have been shown to occur due to failure of the filter layer bond joints caused by tension pressure and thermal stresses applied during back pressure cleaning gas pulses. The work reported here addressed the following issues: Permeability Improvements; Interlayer Bond Strength Improvements; Filter Diagnostic Measurements; Filter Casting Feasibility Study; and High Volume Cost Estimation. 2 refs., 2 figs., 2 tabs.

46417 (DOE/METC–89/6108-Vol.2, pp. 469-478) **Membrane filter technology, RBSN [reaction-bonded silicon nitride] crossflow filters.** Van Ackeren, J. (Allied-Signal Aerospace Co., Torrance, CA (USA)); Strumpf, H. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The overall objective of this program is to develop a ceramic filter based on reaction-bonded silicon nitride (RBSN) material for application in advanced coal burning power systems such as pressurized fluidized bed combustors and/or gasifier systems. The filters are used to reduce anticipated particulate emissions from these advanced power generating systems to acceptable levels by employing long-life, high efficiency components with good cleanability. 2 refs., 9 figs., 1 tab.

46418 (DOE/METC–89/6108-Vol.2, pp. 479-484) **Identification of materials for hot-gas filter tubesheets.** Swindeman, R.W. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract AC05-84OR21400. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objectives of this work are to evaluate current tubesheet designs and materials selection for the support of ceramic cross-flow filters, assess alternative designs, collect design data for commercial and advanced materials, and recommend a tubesheet material and design methodology for high-temperature service. 5 refs., 8 figs.

46419 (DOE/METC–89/6108-Vol.2, pp. 487-495) **A novel concept for the ultimate disposal of off-gases from hot-gas desulfurization processes.** Harkins, S.M. (Research Triangle Institute, Research Triangle Park, NC (USA)); Gangwal, S.K. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

This project is to develop two novel high-temperature high-pressure (HTHP) process concepts leading to the production of elemental sulfur from hot-gas desulfurization off-gases. The first concept utilizes a sodium/alumina (Na/Al_2O_3) sorbent for conversion of hot-gas desulfurization off-gases containing approximately 2.0% SO_2 to a suitable Claus plant inlet gas containing 10 to 50% H_2S. The second concept attempts to produce sulfur in a single step process by reacting the off-gas with a small quantity of reducing gas over a catalyst. 5 refs., 7 figs., 1 tab.

46420 (DOE/METC–89/6108-Vol.2, pp. 496-511) **N_2O formation in combustion systems.** Muzio, L.J. (Fossil Energy Research Corp., Laguna Hills, CA (USA)); Kramlich, J.C.; Samuelsen, G.S. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The overall objective of this contract is to determine the extent to which N_2O is a byproduct of NO_X reduction processes. The specific NO, reduction processes being addressed are (1) selective non-catalytic gas phase NO_X reduction (using ammonia, urea, and cyanuric acid), and (2) reburning with coal as the reburning fuel. 13 refs., 3 figs., 1 tab.

46421 (DOE/METC–89/6108-Vol.2, pp. 512-520) **Microbial removal of SO_2 and NO_X from flue gas.** Sublette, K.L. (Univ. of Tulsa, OK (USA)); Suciu, G.D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objectives of this project have been to investigate the reduction of SO_2 to H_2S by the sulfate reducing bacterium Desulfovibrio desulfuricans in co-culture with mixed fermentative heterotrophs and the microbial reduction of NO to elemental nitrogen. The ultimate goal of the project is the development of a viable process concept whereby a microbial process could impact on the problem of flue gas desulfurization and NO_X removal. 6 refs., 1 tab.

46422 (DOE/METC–89/6108-Vol.2, pp. 521-528) **Super-equilibrium sulfur removal from high temperature gases.**

Chatwani, A.U. (Avco Research Lab., Inc., Everett, MA (USA)); Stickler, D.B. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this program is to investigate the potential of chemical sorbents for sulfur removal from high temperature gases (1600-2400 K) under transient thermal nonequilibrium conditions. The scope of this work is to determine, from single pulse experiments, the effects of various sorbent properties and coal combustion conditions on transient sulfur capture. 3 refs., 9 figs.

46423 (DOE/METC–89/6108-Vol.2, pp. 531-539) **Knowledge based system for fluidization studies.** Reddy, S.M. (West Virginia Univ., Morgantown (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this research project is to develop a knowledge based environment (IPSE: Intelligent Process Simulation Environment) that can assist chemical engineers in simulation and modeling of fossil energy processes including fluidization. The system can enhance the productivity of chemical engineers by enabling them to explore a larger number of alternatives for plant design. The system will also allow the archival and distribution of best experts knowledge for process modeling and can be used as an intelligent tutoring system for process simulation. The framework of IPSE is very general so that it may be used to develop a variety of applications related to process modeling. These include model analysis at various abstraction levels with recommendations for optimizing the plant operation and selection of control logic, algorithmic and thermodynamic options for simulation. 1 ref., 6 figs.

46424 (DOE/METC–89/6108-Vol.2, pp. 540-553) **A study of techniques for reducing ash deposition in coal-fired gas turbines.** Logan, R.G. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Direct coal-fired gas turbines are potentially attractive alternatives to conventional steam cycle electric power generation because of their higher efficiencies. However, the high mineral matter content of coal creates problems with deposition, erosion, and corrosion of turbine components. The rate of ash deposit formation in gas turbines is dependent upon many factors, including particle size, coal ash chemistry, gas and surface temperatures, and particle velocity. The objectives of this study are to identify coal ash components that increase the stickiness of ash particles and process conditions and additives that reduce ash deposition. 14 figs., 1 tab.

46425 (DOE/METC–89/6108-Vol.2, pp. 554) **Mechanistic reactor modeling.** Boyle, E.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of the mechanistic reactor modeling project is the development of accurate, useful, robust models of reactors that are used in the coal utilization industry. Such reactors involve the transport of mass, momentum, and energy of interacting gas and granular solid. Rather than consider the solid to be individual particles, it is treated as a continuum in the same manner as is the gas. A two-dimensional, transient, finite difference code, MFIX, is used to solve the transport equations for interacting solids and gas. Constitutive relations concerning the behavior of the gas, the solid, and their interactions are required for MFIX. The stress tensor for the granular solid is one such constitutive relation. A stress tensor expression suitable for slowly deforming flows as would occur in a moving bed reactor was developed according to the ideas of plasticity theory. This expression has been incorporated into MFIX, and is being tested by simulating the settling of a solid. In a fluidized bed the solid is not usually slowly deforming, and so another solids stress tensor expression has been developed using the kinetic theory of gases. This expression has been incorporated into MFIX and validated by simulating a variety of fluidized beds from bubbling to circulating. A model of a reactor that removes hydrogen sulfide from a hot product gas stream by means of a moving bed of sorbent was developed. The model uses the shrinking core model rate at which the sorbent reacts with the gas. Because a granule in a fluidized bed moves chaotically due to collisions with other particles and buffeting by the gas, a description of a fluidized bed can be found using the theory of Brownian motion. Transport equations for the solids in a fluidized bed assume a granule's velocity is governed by a Markoff process, gas buffeting is normally distributed, and the time between collisions obeys a Poisson distribution.

46426 (DOE/METC–89/6108-Vol.2, pp. 555-566) **Advanced combustion phenomena.** Swanson, M.L. (Univ. of North Dakota, Grand Forks (USA)); Moe, T.A.; Collings, M.E. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The overall objective of the Advanced Combustion Phenomena Program is to expand the scientific and engineering data base for the combustion of low rank coal (LRC) fuels in advanced pressurized combustion systems such as those found in heat engine. Fundamental research on the use of low-rank coal slurries for gas turbine engine applications will develop data that will (1) quantify the potential advantages of low-rank coal's higher reactivity and non-agglomerating tendency; (2) help in determining fuel specifications; and (3) indicate needed design modifications in the gas turbine engines themselves. Research will be directed toward understanding the effects of LRC and slurry properties (including ash level and composition, moisture levels, and slurry rheology) on the combustion efficiency, vaporization and deposition of inorganics, and erosion of materials in pressurized combustion systems. The intent of this research is to establish the relationship between LRC properties and gas turbine engine operational parameters, to compare these relationships with those established for diesel fuel and bituminous coal slurries. 4 refs., 5 figs., 7 tabs.

46427 (DOE/METC–89/6108-Vol.2, pp. 567-572) **Contaminant release and control - NO_x studies.** Casleton, K.H.; Balla, R.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Emissions control is an important aspect of the coal-fueled heat engines program. The objective of the present studies is to investigate the chemical kinetics associated with NOx formation and control mechanisms to support the development of NOx control strategies for advanced heat engine systems. This is being accomplished by means of a combined experimental and modeling approach. The experimental studies to date have utilized a high-temperature photochemistry technique wherein a radical species of interest is generated via the photo-dissociation of an appropriate

precursor molecule. The reaction between the radical and the selected reactant gas is monitored by means of laser-induced fluorescence. Using this method, absolute rate constants for the reaction of CN radicals with H_2, O_2, and the hydrocarbon species methane, ethane, and propane have been measured from room temperature up to temperatures as high as 1500 K. Similar measurements have been made for the reaction CH + N_2, which is thought to play an important role in the prompt-NO mechanism. The CN + O_2, result, while in agreement with recent measurements made at lower temperatures, is in conflict with the recommended value of Baulch et al., and suggests that at 1500 K the rate coefficient is an order of magnitude smaller than previously believed. Modeling studies will determine the consequences of such a reduction in the rate coefficient. NOx modeling studies are using the SENKIN code from Sandia National Laboratory. Kinetic and sensitivity modeling were used to investigate the effects of operating parameters such as pressure, temperature, and stoichiometry on NOx levels, including N_2O. A laminar flame burner system will provide a combustion environment for testing of nitrogen species detection techniques, measurement of species flame profiles for model validation studies, and testing NOx control strategies. 8 figs.

46428 (DOE/METC–89/6108-Vol.2, pp. 573-581) **Single particle combustion studies.** Maloney, D.J.; Monazam, E.R.; Lawson, L.O. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this project is to support the development of coal-fueled heat engines by characterizing important time scales for devolatilization, particle swelling, and char combustion which determine overall burning times in high-intensity combustion applications. The approach taken is to isolate and study the behavior of individual coal and char particles under well-controlled heating conditions. Unique instrumentation has been developed to characterize the rapid changes in particle size, shape, location, temperature, and thermophysical properties which occur during the early stages of the combustion process. These techniques have been applied to a number of combustion-related problems. This paper describes the progress to date in characterizing the transient behavior of fuel particles during the early stages of combustion. The heart of the measurement system is an electrodynamic balance (EDB) in which single particles can be isolated and held at a fixed location for study. The EDB is enclosed in a gas-tight stainless steel chamber for control of the surrounding gas environment. Particles are suspended in the balance and heated from two sides either with a single radiation pulse or with a sequence of heating pulses of preset repetition frequency and duration. The particle response is recorded using a number of imaging and measurement diagnostics. These systems have been applied to study the evaporation and explosive boiling characteristics of coal-water fuels; to determine size and composition changes of evaporating slurry droplets; to time resolve heavy volatile evolution from devolatilizing particles; to measure size and density of fuel particles; to determine heat capacities, and absorptivities of carbon particles; and to study the ignition behavior of char particles. 5 refs., 10 figs.

46429 (DOE/METC–89/6108-Vol.2, pp. 582-589) **A mathematical model for tar release in rapid devolatilization of a softening bituminous coal.** Howard, J.B. (Massachusetts Institute of Technology, Cambridge (USA)); Peters, W.A.; Sarofim, A.F.; Darivakis, G.S. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The overall aim of this research is to produce an experimentally tested mathematical model for predicting tar release rates from coal devolatilization under conditions applicable to suspension firing of pulverized coal. Detailed objectives are: to complete the formulation of the desired tar release model by amplifying an existing evaporative transport/secondary reactions model [Zacharias (1979), with updates by Hsu (1989)] to account for intra-particle transport of tar; to use the new model to predict effects of temperature, heating rate, particle size, and time on tar release rates from rapid devolatilization of Pittsburgh No. 8 bituminous coal, under conditions pertinent to pulverized coal flames; to assess the model performance by examining its predictions of tar evolution behavior, in light of ignition delay times, volatiles flame durations, and experimental data obtained using MIT devolatilization apparatus; and, to use the results to refine the model and/or identify improvement opportunities for longer term investigation. 4 refs., 5 figs.

46430 (DOE/METC–89/6108-Vol.2, pp. 590-598) **Fundamental mechanisms of hot gas cleanup.** Cook, J.M.; Siriwardane, R.V. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The overall objective of this project is to develop both an understanding of and the ability to predict the behavior of sulfur-bearing gases with solid sorbents primarily in gasification processes. These predictive capabilities will then be applied directly to the removal of hydrogen sulfide (H_2S) by zinc titanate or other similar compounds, as well as the removal of sulfur dioxide (SO_2) by hydrated lime, limestone, or other similar sorbent material. The secondary objectives are to: determine the mechanisms by which sorbents capture sulfur, determine the mechanisms by which sorbent regeneration occurs, determine the effect of impurities on both sets of mechanisms, determine the diffusion rate of the sulfur-bearing gas through the product layer that forms on the surface of the sorbent, and determine a formulation of gaseous, pore diffusion in the sorbent.

46431 (DOE/METC–89/6108-Vol.2, pp. 599) **In-bed and in-situ sulfur capture.** Anderson, R.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of these studies is to determine reaction mechanisms and kinetics of high-temperature sulfur capture in gasification and combustion processes. Recent contractor data indicates the potential for substantial sulfur capture within tens of milliseconds in the combustion zone of a coal combustor. Rapid heating encountered by sorbent particles in the combustion zone may modify the characteristics of the sorbent particles sufficiently to account for the substantial capture observed in these contractor tests. In-bed sulfur capture is also an attractive hot gas cleanup option for entrained-bed gasifiers. Contractor results have confirmed the effects of the gasifier utilization and the need for a better understanding of the phenomena. This project is addressing understanding the mechanisms and kinetics of sulfur capture in both these high temperature environments. Current experiments are investigating sulfur capture under combustion conditions using METC's pressurized experimental laboratory combustor (PELC). Using a methane/air flame to simulate coal-fired combustion, sorbent particles of predetermined size and composition are exposed to the high heating rate of the flame front. Sulfur capture as well as sorbent utilization within the combustion zone are monitored by a combination of on-line gas analysis by mass spectrometry and solids analyses subsequent to the tests. The location of a water-cooled, nitrogen-quenched sampling probe allows the selection of precise residence times for both the gas analysis and the collection of solid samples. The results are sets of parametric data on sulfur sorbent performance for a variety of combustion conditions. Such tests allow a determination of

the tolerance of sorbents to sintering and deactivation with exposure to high temperature and short residence time conditions typical of turbine combustors.

46432 (DOE/METC–89/6108-Vol.2, pp. 600-608) **High-temperature inorganic membrane seperations.** McMahon, T.; Gasper-Galvin, L.; Hsu, P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of the inorganic membrane studies at the Morgantown Energy Technology Center is to separate hydrogen from a coal gasification stream using inorganic membranes. The overall operating economics of an integrated gasification combined cycle system can be improved if the hydrogen can be separated from the coal gasification stream, since hydrogen is an important feedstock for many chemical reactions, such as upgrading of raw liquids from a mild gasification process. Tubular porous inorganic membranes with a nominal pore diameter of 40 angstroms are used to separate hydrogen from a simulated gasification stream in this study. As part of a comprehensive experimental program, a lab-scale membrane separation unit has been built and a pilot-plant unit is being designed to test the membranes under actual gasification stream conditions. This paper presents experimental results of the lab-scale unit which show the effect of different temperatures, feed pressures, permeate pressures, and stage cuts on hydrogen separation. This information should prove useful in construction and operation of the pilot-plant membrane unit. 13 figs.

46433 (DOE/METC–89/6108-Vol.2, pp. 609-617) **The kinetics of sulfation of calcium oxide.** Sarofim, A.F. (MIT, Cambridge (USA)); Longwell, J.P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Many studies of high temperature sulfur sorption on limestone exist. The conclusions of these studies are often very confusing, if not contradictory. The limiting rate is often assumed to be either kinetically controlled (Simons, 1987), or product layer diffusion controlled (Borgwardt, 1984), or both (Wen & Ishida, 1973; Bhatia & Perlmutter, 1981a). Values for the initial rate, product layer diffusivity and activation energy also vary significantly from one author to the other. Table 1 gives an overview of the results obtained in the literature. To resolve these conflicts we have selected for study the sulfation rate of very porous synthetic Calcium Oxides (so as to eliminate pore diffusion effects), as well as nonporous CaO single crystals, and CaO submicron ash. By comparing the results obtained with these various samples, it is the purpose to get a clearer picture on the rate-limiting mechanism. Another, related objective of this project is to understand why the mixture of some additives with the lime enhances the rate as observed by Borgwardt (1986). 16 refs., 5 figs., 1 tab.

46434 (DOE/METC–89/6108-Vol.2, pp. 618-631) **Advanced research in instrumentation and control technology.** Sheen, S.H. (Argonne National Lab., IL (USA)); Raptis, A.C. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this program is to conduct advanced research in instrumentation and diagnostic technology needed in coal combustion, pyrolysis, and cleanup processes. The program includes development of control instruments for specific process parameters such as flow rate, temperature, and viscosity, and also development of integrated diagnostic systems for unit process control. The program is currently focusing on development of an online ultrasonic viscometer for monitoring the rheological properties of coal slurries. This viscometer may be developed through measurements of acoustic impedance, attenuation, relaxation, and cavitation properties of the slurry being tested. Acoustic impedance and cavitation methods were examined in FY 1989. The acoustic impedance of a fluid or a slurry can be calculated from the amplitude and phase changes between incident and reflected signals at the interface of two dissimilar boundaries, in this case, the slurry and the transducer wedge. Various designs for the transducer wedge were evaluated for optimum measurement sensitivity, and a wedge with multiple reflections was chosen because its larger contact surface resulted in higher detection sensitivity. For water/glycerin mixtures, results obtained with 5-MHz shear waves indicate that mixtures of higher viscosity produce reflected signals of lower amplitude. However, the amplitude change cannot be measured consistently for coal slurries because of problems such as surface wetting. 4 refs., 10 figs.

46435 (DOE/METC–89/6108-Vol.2, pp. 632) **High temperature fluorescence thermometry.** Shifflett, P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The ability to make accurate temperature measurements in combustion environments is crucial to the understanding and control of fossil energy conversion processes. Although thermocouples are commonly used for combustor temperature measurements, their utility is limited in the extreme environments experienced in coal combustors. In order to circumvent the problems associated with thermocouples, and yet retain many of their advantages, a new optical temperature sensing technique is being developed. The method is based on the temperature dependent fluorescence characteristics intrinsic of certain fluorescent materials and is potentially capable of measuring temperatures up to 2500°F. Other researchers have developed low temperature fiber-optic fluorescence thermometers using ordinary communication grade glass fibers. The objective of high temperature fluorescence thermometry is to extend the temperature range of fiber-optic fluorescence sensors by exploiting the excellent refractory properties of sapphire optical fiber and to develop a non-contact temperature sensor based on the same principles. High temperature fluorescence thermometry relies upon the temperature dependent fluorescence characteristics of certain refractory crystalline materials. By exciting a fluorescent crystal with a pulse of radiation at an appropriate wavelength, and carefully measuring the resulting fluorescence growth and decay, it is possible to determine the crystal's fluorescence time constant. This time constant is a function only of the temperature and is independent of the intensity of the exciting radiation or of the average intensity of the returned fluorescence. The fluorescence technique is potentially capable of very high temperature sensing, is insensitive to amplitude variations or optical attenuations, is immune to electrical interference, and is insensitive to material emissivity.

46436 (DOE/METC–89/6108-Vol.2, pp. 633-640) **On-line particle characterization in highly loaded streams.** Yue, P.C. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

It has been pointed out that in optically thick media the Beer-Lambert law, used to relate light transmission measurements to particle loadings, is not valid due to multiple light scattering effect (Hirleman, 1986). Gouesbet, et al. (1986) described a visible infrared double extinction technique for simultaneous measurements of

particle diameter and concentration in media with high optical thickness. The basis of their technique is the Beer-Lambert law but the multiple light scattering effect was not taken into account in their size and concentration measurements. The objectives of the on-line particle characterization study at the Morgantown Energy Technology Center (METC) are to determine how this effect can be minimized and to develop a correction factor for extending the validity of the Beer-Lambert law to high particulate. 2 refs., 10 figs.

46437 (DOE/METC–89/6108-Vol.2, pp. 645-653) **Smart structures for fossil energy applications.** Claus, R.O. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)); Desu, S.B.; Bennett, K.D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this project is to develop optical fiber sensor methods for the nondestructive on-line evaluation of the degradation and damage of ceramic cross flow (CXF) filters. Smart CXF filters will be developed which will incorporate clad and coated sapphire optical fibers as the sensing elements to determine particle buildup on the filter tiles, cracking of the tiles, and debonding between the tiles. Sensing will be performed using commercially available multimode sapphire optical fiber waveguides at wavelengths in the near infrared. Sensing geometries under consideration include extrinsic backscatter analysis to determine particle buildup, intrinsic high resolution optical time domain reflectometry using reentrant loop methods to interrogate crack dynamics, and short gage length modal domain methods in large V-number fibers to indicate tile delamination. Instrumented CXF filter testing will determine the effectiveness of the sensor systems and the sapphire fiber sensor elements. 8 refs., 5 figs., 1 tab.

46438 (DOE/METC–89/6108-Vol.2, pp. 654) **Fossil energy instrumentation research database.** Nakaishi, C.V. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The purpose of the Fossil Energy Instrumentation Research (FEIR) database is to create and maintain a consolidated system to organize, file, and retrieve fossil energy instrumentation and diagnostic project information. FEIR requires at least an IBM XT compatible microcomputer with 640 kilobytes memory, DOS 3.1, a 20 megabytes hard disk drive, and a blank formatted disk to record updates. FEIR is a menu-driven program and uses both dBase III Plus and WordPerfect 5.0 for data entry, storage retrieval, sorting, and creation of reports. FEIR should provide a cross reference of instrumentation and diagnostic developments to fossil energy managers, instrumentation researchers, and project engineers. The information is organized by the following fields: title, technology area, process area, authors, address, phone number, contract number, date, abstract, and references. FEIR will include the Advanced Research and Technology Development Instrumentation and Diagnostic (AR&TD I&D) projects, as well as known instrumentation developments within other fossil energy projects. FEIR will be provided to ARGTD IGD principle investigators. The principle investigators will be requested to provide yearly updates in order to keep the information current.

46439 (DOE/METC–89/6108-Vol.2, pp. 655-664) **Innovative coal-fueled diesel engine injector.** Kakwani, R. (Adiabatics, Inc., Columbus, IN (USA)); Doup, D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The objective of this research program was to develop an electronic coal-water slurry (CWS) injection system in conjunction with the thermal ignition combustion system (TICS) concept to achieve autoignition of CWS at all engine load and speed conditions without external ignition sources like diesel pilot. 6 refs., 3 figs., 3 tabs.

46440 (DOE/METC–89/6108-Vol.2, pp. 665-668) **Waste characterization.** Junk, G.A. (Ames Lab., IA (USA)); Conzemius, R.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract W-7405-ENG-82. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The original objective of this research was the development of a concept for obtaining mass analysis information for polar, labile, and high molecular weight organic compounds related to different forms of coal utilization. The experimental prototype instrument for testing the concept was planned to feature soft ionization, using picosecond pulsing of a laser beam and ion bombardment onto a solid organic sample, to generate ions that could be characterized by their flight times to an ion collector. Based on theoretical considerations and the results of preliminary studies, the main features of the proposed instrument development and its use were as follows: (1) low cost relative to existing instruments; (2) high ultimate sensitivity and extended mass range; (3) ion source and mass analyzer features not present in current commercial instruments; (4) eventual use of the developed instrument to study compounds of interest in coal research and fossil fuel waste characterization. The original objectives as described above have been slightly changed over time such that the instrument is operable as planned except for the incorporation of an ion gun. This change in plans lowered the development costs significantly with the concurrent loss in instrument capability inherent in the use of the ion gun. However, some studies using the laser desorption technique alone have been very successful and suggest that the instrument should be useful for characterizing components present in fossil fuel process and waste streams. 8 refs.

46441 (DOE/METC–89/6108-Vol.2, pp. 669) **The effect of non-spherical particles on optical sizing measurements.** Woodruff, S.D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

Two dimensional intensity images of the forward scattered light from single particles (coal, soot agglomerates, salt crystals, polystyrene spheres, pollen) are compared to Mie scattering theory to evaluate the effect of particle shape on sizing measurements. The scattered light from a single particle suspended in an electrodynamic balance and illuminated by a laser is digitized by an array detector and mapped by appropriate computer software. While spherical particles demonstrate a close agreement with Mie scattering theory, non-spherical particles show strong deviations from what is predicted by the spherical approximation. The spherical approximation is assumed by all commercially available optical particle sizing instruments and is demonstrated to be invalid for nonspherical particles greater than 10 micrometers in size. The impact on different optical sizing techniques when applied to nonspherical particles as found in actual process streams are discussed.

46442 (DOE/METC–89/6108-Vol.2, pp. 670-680) **The use of gas chromatography/matrix isolation infrared spectroscopy (GC/MI-IR) and supercritical fluid chromatography (SFC) for waste characterization.** Boparai, A.S. (Argonne National Lab., IL (USA)); Green, D.W.; Erickson, M.D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy

Technology Center, PA (USA). Oct 1989. DOE Contract W-31-109-ENG-38. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting. Volume 2.* Order Number DE90000425. Source: NTIS, PC A16/MF A01.

The main objectives of this project are: (1) apply advanced instrumentation, GC/MI-IR, SFE, and SFC for characterization of organic compounds present in coal and coal waste products; (2) develop in-line SFE of coal and related samples which will allow rapid, reproducible, and economical extraction of types of compounds obtained by methylene chloride extraction; (3) optimize conditions for SFE of coal and coal waste samples. The data from these techniques and from analysis by GC/MS are expected to aid in the identification of isomeric and high molecular weight compounds found in coal waste materials. 13 refs., 7 figs., 4 tabs.

46443 (DOE/METC--90/6108-Vol.1, pp. 23-32) **Kinetics of rapid coal devolatilization.** Fletcher, T.H. (Sandia National Labs., Livermore, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this project is to characterize the physical and chemical processes that constitute the early devolatilization phase of coal combustion as a function of coal type, heating rate, particle size and temperature, and gas-phase temperature and oxygen concentration. Subtasks of this project are: (1) Determination of Total Devolatilization Rates. (2) Investigation of Physical Structure Changes During Pyrolysis. (3) Investigation of Chemical Structure Changes During Pyrolysis. (4) Determination of Nitrogen and Sulfur Release Rates. (5) Development of Engineering Models of Devolatilization. Results of this study are intended to apply to pulverized coal combustion systems, and will allow detailed descriptions of the devolatilization behavior for different types of coal based on the local temperature and reaction history. Model descriptions are intended to be simple enough for incorporation into large flame simulation codes, and will be valuable in design or retrofitting of pulverized coal burners. The rate of release of coal pyrolysis products is dependent upon particle temperature and reaction histories. The primary goal of the past three years of research has been to accurately measure the rates of coal devolatilization at high heating rates. Temperatures, sizes, and velocities of single particles in a laminar flow-reactor are measured using a unique infrared sizing pyrometer system. Three major topics are discussed in this report: (a) Devolatilization behavior of different coals, (b) Chemical structure characteristics of tar and char as a function of temperature and reaction history, and (c) Extension of the chemical percolation devolatilization (CPD) model to a wide range of heating rates and temperatures. The devolatilization behavior of five different coals have now been studied in the coal devolatilization laboratory (CDL). Characteristics of these five coals are presented. 11 refs., 4 figs.

46444 (DOE/METC--90/6108-Vol.1, pp. 33-42) **Rates and mechanisms of combustion of pulverized coal chars.** Mitchell, R.E. (Sandia National Labs., Livermore, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The overall objective of this task is to characterize the physical and chemical processes that govern the combustion of pulverized coal chars with respect to coal type, particle size and temperature, and gas temperature and composition. Of particular concern are the apparent and intrinsic burning rates of coal chars and the release rates of nitrogen and sulfur during char burnoff. Efforts are directed toward correlating the intrinsic chemical reactivity of the char and the release rates of nitrogen and sulfur with properties of the parent coal. An effort is also directed toward determining the degree to which particle fragmentation influences local extinguishment or enhancement of burning during the final stages of burnoff. Specific research objectives are associated with the five subtasks indicated above in the FY89 Program Schedule. The experimental endeavor will provide a data base on the reactivities of coal chars and on the release rates of N and S during char burnoff. During the course of this project, data on the combustion characteristics of the chars of ten United States coals ranging in rank from lignite to hva-bituminous have been accumulated. The coals were obtained from the Penn State Coal Data Bank. In addition, data on the combustion characteristics of the chars of three bituminous coals from Australia and a bituminous coal from South America have been accumulated. For each of the coals, the sizes, temperatures, velocities, extents of burnoff, and apparent densities of their char particles burning in 6 and 12 mole-% oxygen in the temperature range 1550 to 1750 K have been measured. For the U. S. coals, the C, H,N, S, and 0 elemental contents, the ash content, and the Ti, Al, Si, Fe, K, Na, Mg, and Ca contents of the ash have been determined as a function of burnoff. Table 1 shows the coals investigated. 8 refs., 3 figs., 2 tabs.

46445 (DOE/METC--90/6108-Vol.1, pp. 43-54) **An engineering model for coal devolatilization.** Niksa, S. (Leland Stanford Junior Univ., CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract FG22-83PC88900. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

This research aims for an engineering model for the evolution of volatile matter from coal during p. f. firing, along with a detailed analysis of the chemistry and transport phenomena in the vicinity of entrained coal particles during combustion, to begin to understand ignition, heat release, and pollutant formation during the initial stages of p. f. firing. A separate task is developing bonafide depolymerization kinetics with reattachment into char, and flash distillation of small, volatile fragments as tar vapor, to explain the behavior of different coal types. The engineering model (FLASHTWO), extends earlier models by explaining pressure effects with flash distillation, and predicts the molecular weight distributions (MWDs) of tar. FLASHCHAIN, the depolymerization model, predicts the complete distributions of all fragments, liquid or vapor, and is based, in part, on the structural parameters deduced from a NMR analyses. The transport analysis of entrained particles, is among the first detailed studies of the interplay among various transport mechanisms and chemical rates in the vicinity of entrained particles during the initial stages of combustion. There are three distinct modeling projects in this program: (1) A reaction model for coal devolatilization which is compatible with large scale combustor simulators yet predicts the yields of tar, gas, char, and unreacted coal throughout the technological operating domain, with heuristic adjustments for different coal types; (2) A theoretical framework based on bonafide depolymerization kinetics with recombination into char which accounts for the behavior of different coal types; and (3) An analysis of the chemistry, heat and mass transport in the vicinity of individual coal particles, to begin to describe the initial stages of the combustion of entrained coal particles. 14 refs., 8 figs., 1 tab.

46446 (DOE/METC--90/6108-Vol.1, pp. 55-64) **Detailed model for practical pulverized coal furnaces and gasifiers.** Smith, P.J. (Brigham Young Univ., Provo, UT (USA)); Smoot, L.D. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The general objective of this study is to improve and extend a generalized two- dimensional, pulverized coal combustion and

gasification code for application to large-scale, practical configurations, and to evaluate and implement the resulting code on an industrial scale. Work during this last year has focused on code integration and evaluation, and 3-D computer graphics pre- and post-processors. This contract has been completed and preparation of the final report is in progress. A workshop on code usage is being organized. Technical papers further documenting the results of the work are being prepared. The accomplishments of this work are serving as the foundation for further extension and refinement of the 3-D combustion code under the National Science Foundation funded Advanced Combustion Engineering Research Center (ACERC). This paper reports briefly on work accomplished during this last year on model development, graphical pre- and post-processing, and overall model evaluation. A three-dimensional reactive flow model for simulating complex, industrial furnaces has been developed, demonstrated, enhanced, and evaluated. Recent advances in computer hardware and in the modeling of partial differential equations have led to increased computational capabilities. This study is an effort to apply this new technology to the simulation of combustion in industrial coal-fired furnaces and gasifiers. A three-dimensional code has been developed specifically for furnaces. This model was used to study several turbulence submodels and numerical issues, including overall efficiency, robustness, pressure-velocity coupling, differencing errors, and grid resolution requirements. 7 refs., 4 figs., 3 tabs.

46447 (DOE/METC–90/6108-Vol.1, pp. 65-74) **Combustion research for advanced heat engines.** Baxter, L.L. (Sandia National Labs., Livermore, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this year's activities for the experimental portion of this work is to identify the role of slurry additives, specifically surfactants, on the formation of aggregates during combustion. This has been investigated by in situ measurements of the particle size distribution of the atomized spray during the vaporization portion of slurry combustion. The experiments were conducted in a laminar flow: reactor in which atomized droplets were entrained. Solid samples are also collected with rapid-quench sampling probes at various stages of combustion to augment the in situ measurements. The objective of this year's modeling activities is to modify an existing comprehensive model of coal-water slurry combustion to predict the effects of particle disaggregation on combustion behavior and to allow the future incorporation of mineral matter evolution submodels. The experiments were conducted in a laminar flow reactor at atmospheric pressure. The reactor entrains a portion of the slurry spray in the vitiated flow of a methane flat flame. An in situ diagnostic is used to measure the particle size and velocity distributions and the particle number density as a function of residence time in this reactor. The experimental results were included in the new version of the comprehensive computer code and then used to predict the effect of particle disaggregation in high-pressure, turbulent heat engine combustors. 10 refs., 6 figs.

46448 (DOE/METC–90/6108-Vol.1, pp. 75-84) **Advanced combustion techniques: Pulse atomization.** Richards, G.A.; Shaw, D.W.; Morris, G.J.; Welter, M.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

A novel utilization of pulse combustion is being tested as a candidate coalwater slurry (CWS) fuel injector. This approach to CWS atomization may offer a number of advantages over conventional air blast atomizers. The objective of the current work is to evaluate the potential use of a pulse combustor to atomize and burn coal-water slurry. Modified CWS air blast nozzles can achieve acceptable performance in gas turbine applications using air/liquid mass ratios as low as 0.5:1 at an atomizing air pressure ratio of 2:1. Considerable benefit could be realized by reducing or eliminating the need to supply high-pressure air blast air. This is shown schematically in figure 1, where an idealized CWS turbine system is considered. The system operates at 10 atmospheres (atm), with a turbine inlet temperature of 2000 F. A conventional air blast atomizer operates at a pressure ratio of 2:1 and an air to liquid ratio (ALR) of 0.5:1. Air blast air is supplied to the nozzle by routing a portion of the combustor air through a second stage boost compressor to supply the needed 2:1 pressure ratio to drive the nozzle. Assuming the combustion air and products have a constant specific heat, C_P of 1000 J/KgK, and considering isentropic compression (i.e.; ignoring compressor inefficiency), it is seen that the work required to compress the needed air blast air reduces the system efficiency by 0.4 %. As an alternative to air blast atomization, it was hypothesized that a small pulse combustor could provide very effective slurry atomization. The pulse atomization concept is illustrated in figure 2. Coal-water slurry (CWS) is injected into the exhaust stream of a pulse combustor where the rapidly oscillating gases can atomize the viscous slurry. Extended testing of high-amplitude pulse combustor has been completed. Tests suggest that repetitive thermal explosions are responsible for the oscillations. 8 refs., 7 figs.

46449 (DOE/METC–90/6108-Vol.1, pp. 87-99) **Optical detection of corrosive compounds.** Oldenborg, R.C. (Los Alamos National Lab., NM (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The overall objective of this program is to develop a laser-based optical diagnostic technique for the direct monitoring of trace levels of corrosive compounds, in particular, gas-phase alkali compounds, within the post-combustion coal gas stream. The diagnostic needs to be compound specific and sensitive to parts per billion (ppb) levels. An attractive option for the future generation of electrical power is to drive gas turbines with fuels derived from the economically priced and domestically prevalent resource coal. However, turbine components are susceptible to corrosion and deposition from even trace amounts of certain inorganic contaminants, particularly the alkali metals and their compounds. Alkali compounds can be destructive at even ppb levels, depending on their composition (halides, hydroxides, sulfates, or oxides) and form (molecular or particulate). Commonly employed analytical methods include techniques based on atomic emission spectroscopy of samples extracted from gas streams. While having the required sensitivity, these methods, which measure the total alkali concentration, lack the desired specificity of composition and form and are inherently limited by sampling techniques. Clearly, new sensitive compound-specific techniques are needed for on-line in situ monitoring of post-combustion streams and to help elucidate the chemistry of these important compounds. The diagnostic currently under development is based on the photofragment fluorescence technique, in which atomic alkali emission is detected upon ultraviolet photodissociation of alkali-containing compounds. Figure 1 is a schematic representation of typical potential energy curves for an alkali compound. The internuclear separation plotted is the coordinate leading to the release of an alkali atom. 8 refs., 7 figs., 1 tab.

46450 (DOE/METC–90/6108-Vol.1, pp. 100-106) **On-line compositional detection techniques.** Chisholm, W.P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

Unique on-line compositional instrumentation is being developed at the Morgantown Energy Technology Center (METC) for the enhanced chemical analysis of high-temperature/high-pressure, fossil-energy-derived process streams. The instrumentation being developed is based on the application of spectroscopy for the analysis of process stream components. Overall, the advanced instrumentation being developed for on-line process stream analysis will have advantages over conventional off-line instrumentation in its abilities to deliver real-time data and to make measurements at or near process stream conditions. This tends to eliminate artifact and contaminant problems typically encountered during off-line chemical analysis. Also, in situ analysis is possible using some of the instrumentation being developed, which affords the scientist and engineer the opportunity to assess reaction mechanisms within the process pipe. The components which are currently being researched for their applicability for analysis using advanced instrumentation include major, minor and trace elements (in vapor, aerosol and solid phases) and certain nitrogen gas species (ammonia [NH_3] and nitrous oxide [N_2O]). Specific reasons for the development of instrumentation to be used in the analysis of process streams and their by-products include environmental assessment, protection of downstream components and determination of the performance of contaminant removal devices. A description of the instrumentation currently being developed is given. 3 figs.

46451 (DOE/METC–90/6108-Vol.1, pp. 107-115) **In situ real-time analysis of particulates.** Ottesen, D.K. (Sandia National Labs., Livermore, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The development of new optical methods for the in situ, real-time analysis of particulates and surfaces in combustion environments offers a major advance over current analytical techniques. Present hardware involves bulky, water-cooled quench probes inserted in the sample stream, and subsequent post-process analyses. In situ measurements will help resolve questions regarding the composition of fuel particles, soot, mineral matter fumes, and condensing particulates in the high temperature environment. The combined measurement of composition, size and velocity for individual particles will permit the calculation of compositional mass flux in particulate-laden flows. Such real-time measurements could also be extremely valuable for monitoring and process control. Laser-based diagnostic techniques are being developed at Sandia for the study of particulates in combustion environments during real time. A technique using a high energy pulsed laser (laser spark spectroscopy) has been employed to measure the elemental composition of individual particles, while a two-color light scattering measurement was developed to extract size and velocity information for single particles. These techniques have been demonstrated at combustion temperatures, and in the collection of both light scattering data and subsequent laser-induced emission spectra from the same individual particle. The laser spark method is particularly sensitive to the metallic elements, and promises to be useful in the determination of particle-to-particle variations of composition of mineral matter transformations during combustion. Major technical progress was made in the study of several reference coals with a wide range of mineral matter content and composition, coal rank, and geographical origin. This data was used for calibration of the spark emission spectroscopic technique for quantitative analysis of reference materials. 4 refs., 4 figs., 2 tabs.

46452 (DOE/METC–90/6108-Vol.1, pp. 119-143) **Fundamental research on surface science in support of physical beneficiation of coal.** Good, R.J. (State Univ. of New York, Buffalo (USA)); Keller, D.V. Jr. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objectives of this work are to obtain the basic surface chemical data, and to develop the relevant surface chemical theory, that will provide a foundation for the oil agglomeration and froth flotation processes of coal beneficiation. Coal can be rendered nearly ash-free, and free from inorganic sulfur, by the oil agglomeration process and also by froth flotation. We are concentrating our efforts on the former. The basic surface chemical properties that control the two processes are, in a general way, the same. In oil agglomeration a coagulum is formed consisting of coal particles held together by liquid bridges of water droplets, in a continuum of oil. The water droplets between coal particles are stable; but those between particles of hydrophilic minerals are unstable, and the hydrophilic minerals are rejected from the coagulum. It is believed that iron pyrite (FeS_2) if cleaved, or released (by fracture) from coal, in wet, reducing conditions, is hydrophilic. High-rank coal is hydrophobic; but with decreasing rank, and increasing oxygen content, coal becomes less hydrophobic; and low-rank coals such as lignite do not respond well to oil agglomeration, because they are hydrophilic. Bituminous coals with high oxygen content may respond poorly to oil agglomeration. But if a surface active additive such as n-octanol is employed, a surface modification occurs, and they apparently become sufficiently hydrophobic that they respond well. The mechanism by which low-rank coal is modified is, no doubt, adsorption; but measurements of the adsorption of higher alcohols on coal have not been made. A theory is needed, that would tell what oil-water-solid contact angles will lead to stable, mineral-free agglomerates. Parallel studies, on several fronts are examined in this investigation. 8 refs., 11 figs.

46453 (DOE/METC–90/6108-Vol.1, pp. 144-152) **Analytical characterization of coal surfaces and interfaces.** Fuller, E.L. Jr. (Oak Ridge National Lab., TN (USA)); Tennery, V.J. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract AC05-84OR21400. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this project is to study the chemistry and structure of coals, including the properties of surfaces and interfaces. Particular emphases are given to the nature of the physical and chemical binding of sulfur and other detrimental components (nitrogen, mineral matter, etc.). The research in this project focuses on gaining a better understanding of these surfaces as related to the reduction of emissions from the various combustion techniques employed for advanced coal utilization projects. Environmental concerns require that combustion processes must be made more efficient and cleaner. The cleanup of the feedstocks for this direct utilization of coal is preferred over the stack gas cleanup to avoid insult to health and environment. Separation of the residual amounts of noxious species from coal requires a more complete knowledge of the interaction of the various components across the surfaces and interfaces. Existing industrial processes are capable of removing some of the noxious components, but fall short of the desired goals that exist presently and/or will be mandated by legislation for cleaner exhausts. A more detailed understanding of the microstructure and surface chemistry is needed. The facilities at Oak Ridge National Laboratory are designed and developed to study the microstructure and the surface reactions of the type involved in the coal preparation processes. Most studies are on a laboratory scale but are strongly oriented to existing and proposed engineering programs. In this manner, the fundamental data are most quickly and economically applied to the industrial processing. This is a multifaceted program, involving several techniques for the characterization of the chemistry and structure of coal surfaces and interfaces.

46454 (DOE/METC–90/6108-Vol.1, pp. 155-162) **Fluid flow control device.** Novack, M. (General Applied Science Labs., Inc., Ronkonkoma, NY (USA)). USDOE Morgantown Energy Technology

Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract AC21-88MC24217. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objectives of this research program are to further develop a fluid friction control device (FFCD) for pressure reduction applications encountered in coal conversion and other processes at temperatures up to 1800°F and pressure up to 750 psig. The research is expected to improve the performance and reliability of the design and to further understand possible failure modes. In order for the FFCD technology to be transferred to the private sector, an agreement shall be made with a valve manufacturer to seek out markets for the FFCD and undertake production when market conditions are favorable. Conventional control valves normally used in coal conversion plant pressure letdown applications are subjected to high pressure - high temperature service in an environment leading to valve erosion and corrosion. The FFCD is designed to dissipate friction induced energy losses uniformly over an extended surface flow path, and thus eliminate pressure reduction taking place in a single-step process. This feature of the FFCD, in which fluid velocity is reduced, has the potential of minimizing or eliminating the problem associated with a conventional control valve when subjected to coal conversion plant pressure letdown conditions. The principal of the FFCD is illustrated. The specific tasks required to accomplish the project goals are as follows: (1) Small Test Loop - Modify existing test apparatus to enable testing of a small-scale FFCD. (2) Small-Scale FFCD Fabrication and Testing - Valve to operate over a range of test parameters. Manufacturing and marketing considerations shall be included in a topical report. (3) Large Test Loop - Design and construct a larger test loop for testing a scaled-up FFCD. (4) Scaled-up Valve Fabrication and Testing - Fabricate and test a larger FFCD, incorporating the best design techniques developed from prior testing. 1 ref., 3 figs.

46455 (DOE/METC–90/6108-Vol.1, pp. 163-171) **Valveless ash removal from pressurized fluid-bed combustion systems.** Hauserman, W.B. (Univ. of North Dakota, Grand Forks (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this project is to demonstrate that hot ash can be removed from a pressurized fluidized-bed combustion (PFBC) system through a column of cheaply replaceable, coarsely crushed rock, in place of expensive, erosion-prone letdown valves. It is a further objective to predict the economic advantage of such a gravel bucket letdown device over a conventional lockhopper system, in which a major operating expense is the replacement of valve trim. This project will test an extension of the gravel bucket principle, in which an erosive, high-pressure slurry passes through a bed of crushed rock with an adjustable flow path and cross-sectional area. The concept was inspired by the valve erosion problems of coal liquefaction plants. Valve erosion incurred in getting either a slurry or gas-borne solid out of any pressurized coal conversion or combustion system will be the major maintenance expense. This project extends the gravel bucket approach to removing solids from PFBC systems. If successful, a hot-gas gravel bucket could offer an economic alternative to a lockhopper plus a pair of expensive block valves. Research to date has identified the upward flow, reverse fluidized-bed, as a preferred design concept. Ash-bearing gas flows upward through crushed rock, which is supported against a perforated plate when the pressure drop through the bed exceeds the bed's weight and the superficial gas velocity exceeds the terminal settling velocity of the largest particles. Thus the pressure drop through the packed bed can greatly exceed the bed weight, enabling the use of a much smaller volume of rock than would be needed to provide the same pressure drop by a packed or fluidized bed held down by gravity. If the bed becomes plugged, the flow decreases and aerodynamic forces supporting the bed decrease, allowing the bed to expand downward, releasing the impacted ash. Test results are plotted. 5 refs., 5 figs., 1 tab.

46456 (DOE/METC–90/6108-Vol.1, pp. 175-222) **Transformation of inorganic coal constituents in combustion systems.** Flagan, R.C. (California Institute of Technology, Pasadena (USA)); Bryers, R.W.; Sarofim, A.F.; Beer, J.M.; Peterson, T.W.; Wendt, O.L.; Huffman, G.P.; Huggins, F.E.; Helble, J.J.; Srinivasachar, S. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objectives of the project are: (1) elucidation and quantification of the physical and chemical processes that occur in an environment typical of pulverized coal combustion, and which control the partitioning of coal mineral constituents among products (residual ash, aerosols, and vapors). (2) Chemical and physical characterization of the coal, its intrinsic, included, and extraneous mineral forms, and the spectrum of ash-related products in detail. (3) Development of a tractable, mechanistic model capable of predicting the observed features of the mineral matter transformation process. To better understand the transport, deposition, and emission characteristics of combustion-generated ash, it is first necessary to fully understand the factors governing the formation of ash during the combustion process. In this project, we are seeking to understand mineral transformations by testing the hypothesis that the transformation and partitioning of inorganic constituents into ash products are determined by two important features: (1) the individual mineral forms (size and association with adjacent minerals and carbon); and (2) temperature history of the gas phase environment encountered by the coal/ash particles. If this hypothesis is proved correct, then new methods for characterizing coals and their minerals, combustion testing methodologies, and slagging/fouling indices need to be developed to properly incorporate the heterogeneous nature of the coal/minerals and the combustion environment. 48 refs., 24 figs.

46457 (DOE/METC–90/6108-Vol.1, pp. 223-232) **The fate of mineral matter during pulverized coal combustion.** Baxter, L.L. (Sandia National Labs., Livermore, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The long-term objective of this project is to gain quantitative understanding of the rates and mechanisms of selected aspects of mineral matter evolution, transport and deposition under conditions relevant to pulverized coal combustion. These selected aspects of mineral matter evolution include: (1) release of inorganic material from coal particles during reaction of the organic and inorganic portions of the particle and by vaporization; (2) changes in mineral matter composition during combustion; (3) size distributions of flyash formed during combustion; and (4) deposition of mineral matter on surfaces. These aspects of mineral matter evolution are studied as a function of coal and mineral type, total ash loading, rate of organic and inorganic reaction, local gas conditions, and time. The two major subtasks are: (1) Particle Fragmentation and (2) Mineral Matter Transformations During Coal Combustion. This project represents a fundamental investigation of mineral matter behavior during combustion that is focused on practically relevant aspects of the topic. The first sub task addresses the topic of particle fragmentation and flyash formation and studies the relationship between flyash particle size distributions and char particle size distributions. The experimental portion determines the extent of particle fragmentation during char oxidation. The theoretical portion deduces physical and mechanical mechanisms for fragmentation from these data. The modeling portion of the project involves incorporating the findings into a fragmentation submodel and then into a comprehensive computer code. The second sub task addresses

the topic of transformations of mineral matter during coal combustion. These are broadly categorized into areas of mineral matter release from coal particles, coalescence of residual mineral grains in the particle, and chemical/physical transformations of the mineral grains. 10 refs., 5 figs.

46458 (DOE/METC–90/6108-Vol.1, pp. 233-241) **Combustion inorganic transformations.** Benson, S.A. (Univ. of North Dakota, Grand Forks (USA)); Zygarlicke, C.J.; Steadman, E.N.; McCollor, D.P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract FC21-86MC10637. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The overall objective of this project is to develop a unified picture of the physical and chemical changes that occur in coal inorganic matter during combustion. The research is centered on three main tasks: (1) developing the computer-controlled scanning electron microscope/microprobe methodology to determine the distribution of mineral grains in pulverized coals; (2) determining the inorganic components in coal and coal ash-derived components from coals and ashes; (3) study the physical and chemical changes of inorganic components in coals and model mixtures using a drop-tube furnace. Many operational problems encountered during combustion of coal in utility boilers are related to the inorganic constituents of the coal. The problems include: deposition on heat transfer surfaces; formation of fine particulate that is difficult to collect; and erosion and corrosion of boiler parts. To date, the inorganic components in four coals and their transformations during combustion have been examined in detail. The inorganic components have been determined by a combination of CCSEM (1) and chemical fractionation (2). The transformations of inorganic components have been examined during coal combustion. The results summarized in this report will include only those obtained in experiments with Upper Freeport bituminous coal from Pennsylvania. The size and composition of the mineral grains determined in polished sections of coal are summarized in Table 1 for the 53-74-micrometer-sized fraction of Upper Freeport. 3 refs., 2 figs., 3 tabs.

46459 (DOE/METC–90/6108-Vol.1, pp. 242-251) **Fluid mechanics of ash deposition.** Shaffer, F.D.; Ramer, E.R.; Chen, J.L.S.; Mathur, M.P. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this project is to develop a predictive capability for the delivery of ash particles to heat exchanger tube surfaces. The approach taken to meet this goal is to make detailed measurements of the gas and particle flow fields through tube banks. These measurements will be used to develop empirical correlations for the impact of particles on tube surfaces. The empirical information will also be used to evaluate and improve the predictions of computational fluid dynamics (CFD) models. Overall ash deposition rates are determined by a balance between two interacting factors: the delivery of ash particles to tube surfaces and the ability of the tube surface (including a layer of ash deposits) to capture ash particles. This study is concerned only with the former. It does not encompass the formation of ash particles, nor the capture ability of a tube surface. Only the behavior of ash particles once they enter a tube bank is considered and only particles driven by a combination of gas drag, gravitational and inertial forces. The approach taken is to perform an experimental investigation of the gas and particle flow fields though tube banks. A simulation of the gas and particle flow fields in an actual combustor is achieved under laboratory, room-temperature conditions. Much of the FY89 effort was devoted to completing a laboratory facility to create and measure gas-particle flow fields. It is called the Particulate Flow Analysis Facility (PFAF). Two unique flow-diagnostics systems have been developed as a part of the PFAF: a smokeline visualization system and a particle-image-velocimetry (PIV) system. With the smokeline visualization system, gas streamlines, gas path lines and the transition from steady to unsteady flows (including laminar to turbulent flows) can be observed and measured. The PIV system measures lagrangian particle flow information. A detailed description is given. 10 refs., 11 figs.

46460 (DOE/METC–90/6108-Vol.1, pp. 252-255) **Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment.** Rosner, D.E. (Yale Univ., New Haven, CT (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The emphasis in the present program is on developing and experimentally validating rational theoretical methods for predicting the role of inertia and ash particle thermophoresis in determining net deposition rates. The project is currently active in the following tasks: (a) Developing laboratory techniques to produce a high speed combustion gas jet laden with both inorganic particles of controlled size, and alkali sulfate vapor; as well as techniques to experimentally determine particle thermophoretic diffusivities. (b) Experimentally and theoretically studying the aerodynamic, and thermophysical factors governing impacting particle capture (and, ultimately, the ability of impacting particle to dislodge previously deposited particles). (c) Extending our recent experiments and correlations of particle deposition to include the simultaneous effect of two (or more) deposition mechanisms (e.g. inertia + thermophoresis) and recommend methods to predict deposition rates for geometries of engineering importance using available heat and momentum transfer data. (d) Evaluating the importance of photophoresis in the transport of small IR-absorbing particles in large fossil-fueled combustors and furnaces. (e) Initiating the evaluation of Brownian and thermophoretic properties of unsymmetrical particle aggregates. (f) Establishing quantitative relationships between particle deposition mechanism and the resulting particulate deposit microstructure. Recent accomplishments are discussed. 15 refs.

46461 (DOE/METC–90/6108-Vol.1, pp. 256-265) **Radiative properties of ash and slag.** Solomon, P.R. (Advanced Fuel Research, Inc., Hartford, CT (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this project is to make laboratory measurements of the radiative properties of ash and slag deposit samples that have been extracted from combustion devices. The results from this project will lead to an improved understanding of combustion system operation. This paper describes the determination of the radiative properties of deposits from combustion devices. Measurements of radiative properties of materials at high temperatures are made by a technique employing a sample heating device that is coupled to a Fourier Transform Infrared (FT-IR) spectrometer to measure emission, hemispherical-directional transmission, and hemispherical-directional reflection of a sample. By this technique, the temperature at the measurement point and the spectral emittance (emissivity) of the surface can both be obtained. The complex index of refraction that is required to calculate emissivities is determined by a transmission spectroscopic technique that employs fine sample particulates suspended in KBr and CsI matrices. 6 refs., 3 figs., 1 tab.

46462 (DOE/METC–90/6108-Vol.1, pp. 266-278) **Optical properties of fly ash.** Self, S.A. (Stanford Univ., CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development,

Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The aim of this project is to provide a fundamental scientific basis for understanding and calculating radiative heat transfer in coal combustion systems, particularly as influenced by the presence of inorganic constituents deriving from the mineral matter in coal. In practice, it is not possible to invert measurements of the optical properties of a particulate dispersion to infer the size and refractive index distributions of the particulates. Even if one knows the size distribution from independent measurements, one can infer, at best, only some effective average refractive index. Because of the impracticality of obtaining fundamental data on the complex refractive index of particulates from measurements on a polydispersion, and in view of the heterogeneity of composition of fly ash, an alternative strategy-has been adopted. The basic approach is to measure the optical constants (i.e. the components n, k of the complex refractive index) on bulk samples of synthetic slags, for which reliable techniques are available. Such measurements are being made over relevant ranges of wavelength, composition and temperature, and will constitute the fundamental data base for computing radiation transfer in fly ash laden combustion gases. To utilize such data on the optical constants of slag in calculations of radiation transfer in dispersions, it is also necessary that the ash be characterized with respect to its size and composition distributions. Characterization of a range of ashes constitutes a second component of the work. It should be recognized that this basic approach rests on the fortunate fact that the vast majority of fly ash particles are spherical, optically isotropic (because they are vitreous) and homogeneous, although the composition varies significantly from particle to particle. 7 refs., 4 figs., 1 tab.

46463 (DOE/METC–90/6108-Vol.1, pp. 281-300) **Wear reduction systems: Powder-lubricated piston rings for coal-fired diesel engines.** Heshmat, H. (Mechanical Technology Inc., Latham, NY (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The overall objective of this program is to deal with the problem of severe wear occurring on the piston rings and liners of coal-water-slurry (CWS) fueled engines. A secondary concern is the contamination of the crankcase oil by the coal combustion products. The new approach for the resolution of this difficulty consists of replacing the present oil-lubricated system with a powder-lubricated system that would utilize coal ash, either alone or in combination with another powder. The feasibility of this particular lubrication concept for reducing ring/liner wear is to be demonstrated in a series of experiments utilizing redesigned and properly selected components. Wear performance of suitable ring/liner materials lubricated with a powder that incorporates the abrasive ash particles is to be evaluated in terms of load capacity, friction, and rate of wear. New concepts of quasi-hydrodynamic lubrication and appropriate experimental techniques are employed to arrive at the best combination of ring design, ring and liner materials, and powder constituents. This new technology relying on the quasi-hydrodynamic formation of a film by a powder lubricant offers a possibility of significantly reducing wear in CWS-fueled engines. In addition, the use of a powder-lubricated system in the upper portion of the cylinder can be made to isolate the particulates from the lower portions of the engine, thus further reducing engine wear. With these tasks accomplished, semi empirical relationships and experimentally proven design data should become available for the design of a powder-lubricated system for operational piston rings. The final product of this project will be the development of a conceptual design for the installation of powder-lubricated piston rings in a full-scale CWS-fueled diesel engine. Results and accomplishments are discussed. 27 refs., 17 figs., 3 tabs.

46464 (DOE/METC–90/6108-Vol.1, pp. 301-310) **Wear reduction system - Liquid piston ring.** Raymond, R.J. (Tecogen Inc., Waltham, MA (USA)); Chen, Tze-Ning; DiNanno, L. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The primary objective of this project is to gain a fundamental understanding of the physics of the liquid piston ring concept and to establish its technical feasibility for solving the problem of cylinder liner and piston ring wear in coal-fueled reciprocating engines. This concept involves maintaining a liquid piston ring above the top metallic piston ring to prevent ash from coming into contact with piston rings and cylinder liners which are in relative motion, thereby allowing the use of conventional materials. To establish the technical feasibility of this concept, the following technical issues are to be investigated: (1) Particle scrubbing from the cylinder surface. (2) Leakage of liquid into the combustion chamber. (3) Leakage of liquid past the piston ring. Heat transfer and evaporation of the liquid. (4) Circulation and cleaning of the liquid. Lubrication of the piston ring. The problem of high component wear in reciprocating coal-fueled engines has been identified as one of the main obstacles in the development of diesel engines operating on coal/water slurry. There are two approaches to dealing with the ash present in the engine cylinder after combustion. In the first approach, the engine is constructed with component materials that operate with ash present at rubbing surfaces and retain acceptable wear rates. Some encouraging results have been reported based on a short-duration test of coated piston rings and liners. The second approach is to prevent the ash from coming into contact with surfaces that are in relative motion, thereby allowing the use of conventional materials. The liquid piston ring concept is based on the latter approach which is discussed in this paper. 6 refs., 11 figs.

46465 (DOE/METC–90/6108-Vol.1, pp. 311-321) **Fluidic coal feed system.** Kamo, R. (Adiabatics, Inc., Columbus, IN (USA)); Holmes, A.; Kumar, S. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046–: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objective of this program is to improve the operating life of coal slurry fuel controls and injector components through the use of fluidic technology. No-moving-parts fluidic fuel control and injection systems are to be analyzed, designed, bench tested and engine tested to confirm that the problems of wear and clogging can be significantly reduced or eliminated in a coal slurry fueled diesel engine. Specific technical objectives include: (1) Identification of fluidic flow control and atomization techniques that are applicable to the design of coal slurry fuel injector functions. (2) Design, fabrication and bench testing fluid control components which can be used to implement control or injection circuits. (3) Design, fabrication and bench testing of a breadboard fuel injection system which combines the individual fluidic components into a complete system. (4) Design, fabrication and bench and engine testing of a fluidic fuel injector in a coal fueled diesel engine. The two major problems which limit the usefulness of coal as an alternate fuel in diesel engines are: the inability to efficiently atomize coal slurry fuels, and material wear due to particulate matter in the fuel. This project addresses the application of fluidic devices to solve the problems of efficient atomization of coal slurry fuel and of injector component wear. The investigation of injector nozzle orifice design emphasizes reducing the pressure required for efficient atomization. The effort to minimize injector wear includes the novel design of components allowing the isolation of the coal slurry from close-fitting injector components. The program has identified several types of fluidic devices which are applicable for use with coal slurry fuel. A review of the technology and nomenclature is given. 2 refs., 18 figs.

46466 (DOE/METC–90/6108-Vol.1, pp. 325-335) **Assessment of fouling, erosion, and corrosion of coal-fired gas turbines.**

Ahluwalia, R.K. (Argonne National Lab., IL (USA)); Im, K.H. USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The project objective is to update particle and vapor deposition models and to issue final reports on fouling of gas turbine passages and on sodium-sulfate hot corrosion of turbine superalloys. The development of coal-fired gas turbines requires deposition, erosion, and corrosion (DEC) protection of turbines from ash contaminants in the products of combustion. The severity of turbine degradation depends upon a number of variables including coal ash thermochemistry, ash content, combustion particulate size distribution, gas temperature, surface temperature, and blade aerodynamics. The present task has been concerned with the development of semiphenomenological models for predicting DEC modes of interaction between and contaminants and the blade surface as a function of turbine operating conditions and fuel chemistry. Fouling of coal-fueled gas turbine passages is perceived as being a highly complex problem. A number of factors must be considered because they affect either the rate and mechanism of contaminant delivery to the blade surface, or physical interaction (adhesion) between the contaminants and blade/deposit surface, or spallation of deposit. Results and accomplishments are presented for: (1) particle delivery, (2) particle size distribution, (3) slurry atomization, (4) coal combustion, (5) coal beneficiation, (6) blade cooling, (7) turbine inlet temperature, (8) sorbent injection, (9) deposit cleanability, and (10) sodium sulfate induced hot corrosion. 16 refs., 2 tabs.

46467 (DOE/METC–90/6108-Vol.1, pp. 336-347) **Low-pressure-ratio regenerative exhaust-heated gas turbine.** Wilson, D.G. (Massachusetts Institute of Technology, Cambridge (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The objectives are to study the exhaust-heated regenerative gas-turbine cycle in the form incorporating a high-effectiveness periodic-flow regenerator to decide on its feasibility, attractiveness and promise as a coal-fired power unit. Preliminary designs will be made of four alternative versions of the cycle. Two alternatives are the basic cycle with and without an intercooler in the compressor. For each of these alternatives, the type, size and configuration of the resulting engine are to be found if it is designed optimally from a clean sheet (the blue-sky design), and if the engine is designed using the maximum degree of commonalty with one or more existing engines. The size and configuration of a ceramix-matrix rotary regenerator will also be found. Because the feasibility of the cycle depends critically on the performance of the regenerator when operating between the clean compressed air delivered from the compressor and the products of coal combustion in the turbine exhaust gases (using the best available technology for the combustion and gas-cleanup system), an objective of the first part of the program is to examine the behavior of coal-ash particles as they impact actual rotating ceramic-matrix regenerators and are carried under the seal regions, and as they respond to various alternative methods of particle removal. Results and accomplishments are presented. 9 refs., 6 figs.

46468 (DOE/METC–90/6108-Vol.1, pp. 348-357) **Advanced turbine design for coal-fueled engines.** Wagner, J.H. (United Technologies Research Center, Hartford, CT (USA)). USDOE Morgantown Energy Technology Center, WV (USA); USDOE Pittsburgh Energy Technology Center, PA (USA). Oct 1989. DOE Contract AC21-89MC26052. (CONF-891046--: Advanced research and technology development, Morgantown, WV (USA), 3-5 Oct 1989). In *Proceedings of the advanced research and technology development direct utilization, instrumentation and diagnostics contractors review meeting.* Order Number DE90000424. Source: NTIS, PC A15/MF A01.

The primary objective of this project is to identify and test turbine airfoil shapes and aerodynamic characteristics which may result in improved turbine and vane life for coal-fueled heat engines. The effects of particles on turbine airfoil erosion will be determined analytically with the airfoil aerodynamic flow field and a particle trajectory analysis. Although most of the analytical work with the 2-D trajectory analysis will be focused on the aerodynamics at the mid span location, a literature survey and an exploratory analysis of the 3-D flow effects on the erosion characteristics will be conducted. A better understanding of the effects of the turbine stage design parameters on erosion may lead to improved turbine life through the effective management of particles from the combustion process. Erosion results for the airfoils of each turbine stage will be compared to the results of the baseline stage. Criteria for the comparison of the results will include local peak values of erosion as well as integrated surface averages. In this manner each turbine stage design will be rated for erosion resistance. Typical baseload operating conditions for the turbine simulation have been specified. Gas products of combustion of CWS (Coal Water Slurry) fuel have been determined for mean line, flow path and trajectory calculations. The mean line design for the baseline turbine has been completed. Particle rebound parameters have been developed from the literature and are used in the trajectory calculation code. A literature survey of erosion results has been completed. A basic erosion model has been chosen and incorporated in a post processing trajectory analysis code (PPTAC). The ranges of particle parameters for analysis have been established. Particle trajectory calculations for the baseline turbine first stage have been completed. Technical items are discussed in detail. 18 refs., 5 figs., 1 tab.

46469 (DOE/PC/88913–T6) **Mechanics/heat-transfer relation for particulate materials: Quarterly report.** Campbell, C.S. University of Southern California, Los Angeles, CA (USA). Dept. of Mechanical Engineering. Jul 1990. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88913. Order Number DE90016760. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This investigation was originally intended to investigate a linkage between the particle pressure and the heat transfer behavior in a fluidized bed. This quarter we compared the heat transfer behavior of the system to the particle pressure. As was anticipated, the comparison was not very favorable. We have also been continuing with the dry shear cell experiments and the suspension conductivity shear cell is nearly ready to begin operation. 7 refs., 5 figs.

46470 (ECN-C–90-023) **Chars in a fluidized bed: Image analysis and a model.** Van Engelen, A.; Van der Honing, G.; Hamburg, G.; Roos, C.M.; Vleeskens, J.M. Netherlands Energy Research Foundation, Petten (Netherlands). May 1990. 42p. (In Dutch). Contract NOVEM 20.35-063.10. Order Number DE90519650. Source: NTIS (US Sales Only), PC A03/MF A01.

The combustion of chars depends on the temperature and particle size. The combustion process parameters are determined by the dominant combustion regime. The purpose of the investigation into the title subject is to verify the combustion mechanisms, found in the literature, by means of optical analysis, and subsequently, to determine relevant parameters for the char combustion. The pore size was measured by means of optical image analysis. The changes in the pore size during different combustion stages was measured for temperature ranges specific for the regimes in which limitations caused by external diffusion, respectively pore diffusion and reaction kinetics occur. Partial pyrite oxidation in large pores was observed by means of roentgen-spectrochemical analysis and optical microscopy (TAS). It appears that for a high temperature (900 C) the combustion is external diffusion limited. At a low temperature (400 C) the results of the analysis do not lead to identification of the combustion regime. 26 figs., 4 tabs., 13 refs.

46471 **Dependence of char combustion factors on the initial particle density.** Essenhigh, R.H. (Dept. of Mechanical Engineering, Ohio State Univ., Columbus, OH (US)). pp. 327-332 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446--: Combustion Institute spring meeting: combustion

fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses a relationship between the density and diameter of char particles. Fundamental properties involved in the char reaction are examined and prior theoretical work is represented.

46472 An engineering rate equation for pyrolysis of small coal particles. Misra, M.K. (Dept. of Mechanical Engineering, Ohio State Univ., Columbus, OH (US)); Essenhigh, R.H. pp. 319-326 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446--: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper presents a model constructed to predict pyrolysis behavior under different heating conditions. Results of calculations are compared with a complied data base.

46473 Single coal particles pyrolysis: Effect of non-isothermalities. Tran, P.X. (US Dept. of Energy, Pittsburgh Energy Technology Center, Pittsburgh, PA (US)); Mathur, M.P. pp. 313-318 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446--: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses the transient processes occurring in the interior of a coal particle undergoing heating and devolatilization. The authors investigate the effects of heat transfer and the devolatilization rate on the rate of the intra-particle heating.

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 46480, 46481, 46482, 46483

46474 (DOE/EIA–0121(90/1Q)) **Quarterly coal report, January–March 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 20 Aug 1990. 141p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. Order Number DE90016799. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Quarterly Coal Report provides comprehensive information about US coal production, exports, imports, receipts, consumption, and stocks to a wide audience, including Congress, federal and state agencies, the coal industry, and the general public. The data presented in this report are collected and published by the Energy Information Administration (EIA). 7 figs., 37 tabs.

46475 (DOE/EIA–0125(90/1Q)) **Coal distribution, January–March 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 29 Aug 1990. 108p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90017412. Source: NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

The Coal Distribution report provides information on coal production, distribution, and stocks in the United States to a wide audience including Congress, federal and state agencies, the coal industry, and the general public. The data in this report are collected and published by the Energy Information Administration. 6 figs., 34 tabs.

46476 (GAO/NSIAD–90-96) **Military installations: Coal inventory and consumption in the Federal Republic of Germany.** General Accounting Office, Washington, DC (USA). National Security and International Affairs Div. Mar 1990. 28p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report has reviewed the use of U.S. coal at DOD installations in West Germany. DOD reported that between April 1, 1988, and December 31, 1988, it had between 306,000 and 419,000 tons of U.S. coal stored in Germany. About two-thirds of that was anthracite coal. GAO visited six coal-handling locations that accounted for 72 to 79 percent of the total U.S. coal between April and December 1988. This report could not verify the official inventory records at five locations - two Air Force and three Army - for several reasons, including a lack of required physical inventories of coal for recent years. DOD's coal consumption data for fiscal year 1988 appeared to be accurate since it matched the data reported on source documents maintained at the installations and their commands. According to reported DOD coal inventory and consumption data, as of September 30, 1988, DOD had enough anthracite coal on hand to satisfy projected demands through at least fiscal year 1993, given that no additional heating plant conversions other than those already approved occur and no additional shipments of coal occur. DOD said that as of September 30, 1988, it facilities in Germany had enough anthracite coal on hand to last a minimum of five years.

46477 (NEDO-P–8918) **Estimation of coal usage technologies in relation to CO_2 for gloval environment.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 108p. (In Japanese). Order Number DE90517226. Source: NTIS (US Sales Only), PC A06/MF A01.

The present report evaluated the coal usage technologies, corresponding to the gloval scale environment problem due to CO_2. The human race, consuming annually about 19 billion tons of oil, coal, natural gas, etc. in 1984, discharged about 5.2 billion tons, calculated with conversion to carbon, of CO_2. It is the present status that every country is at a loss how to estimate serious influence of cost, required for measures to decrease CO_2 in quantity, on its national economy. Japan is 277 million tons, calculated with conversion to carbon, in discharged quantity of CO_2, which occupys 4.8% of the worldwide total. In electric power, iron and steel, cement, oil, city gas chemical and other principal industries, energy saving will be most prior in decreasing in quantity of CO_2, and technical innovation will become necessary even in categories of business having little room for energy saving. In both coal liquefaction and gas gasification processes, as a coal utilization technology, not only the optimization of existing processes but also the urgent development of new processes are the most important. 27 refs., 49 figs., 40 tabs.

46478 (PB–90-247255/XAB) **Coal economics data base: Economics of fuel use in industrial boilers. Final report, February-December 1983.** Klein, D.E.; Ebert, C.D. ICF, Inc., Washington, DC (USA). Dec 1983. 110p. Contract GRI-5081-511-0547. Source: NTIS, PC A06/MF A01.

Based on GRI's 1982 Baseline Projection assumptions for oil and natural gas prices, this analysis indicates that steam requirements in the industrial sector will be met increasingly by coal-fired systems. The expectation of greater coal usage in industrial boilers largely depends on the basic costs of competing boiler systems. Uncertainties that could affect the rate and the extent to which industrial facilities convert to coal include the rate of economic growth, the rate at which existing facilities must be replaced, the development of alternative technologies, and many site-specific factors that can substantially increase the cost of consuming coal.

0160 Health and Safety

46479 (PB–90-245929/XAB) **Indoor air exposure to coal and wood combustion emissions associated with a high lung cancer rate in Xuan Wei, China.** Mumford, J.L.; Chapman, R.S.; Harris, D.B.; He, X.Z.; Cao, S.R. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1989. 8p. (EPA–600/J-89/403). Source: NTIS, PC A02/MF A01.

Pub. in Environment International, Vol. 15, 315-320(Nov 1989).

Residents of Xuan Wei County in China have unusually high lung cancer mortality that cannot be attributed to tobacco use or occupational exposure. They are exposed to smoke from unvented, open pit coal or wood fires (often used for cooking and heating). The variation in lung cancer rates among communes within the county suggests that indoor combustion of smoky coal may be the prime determinant of lung cancer. To characterize the air in Xuan Wei homes, samples of the air particles and semivolatile organic compounds were collected from homes located in two communes; one commune has a high rate of lung cancer, and the other has a low rate. Samples collected in the commune where the lung cancer

rate is high and where smoky coal is the predominant fuel contained high concentrations of small particles with high organic content; organic extracts of these samples were mutagenic. Samples from homes in the wood-burning commune, which has a low rate of lung cancer, consisted mostly of larger particles of lower organic content and mutagenicity. The smoky coal sample was a mouse skin carcinogen and was a more potent initiator of skin tumors in comparison to the wood or smokeless coal sample.

0170 Legislation and Regulations

Refer also to citation(s) 46916

46480 (PB–90-240300/XAB) **Cost impact of discretionary alternatives. OSM Permanent Regulations 30 CFR, Chapter 7.** D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA (USA). 11 Jun 1990. 478p. Source: NTIS, PC EE99/MF E99.

Set includes PB–90-240318 through PB–90-240334.

The chapter describes the policy issues and alternatives which were considered in assessing the economic impact of compliance with land reclamation mining laws. Models of surface mines and underground mines which were used in the analysis are described. Forty-one discretionary policy issues were defined by the Office of Surface Mining, though all were not applicable to underground mining. Each of the three volumes of this report have been indexed separately.

46481 (PB–90-240318/XAB) **Cost impact of discretionary alternatives. OSM Permanent Regulations 30 CFR, Chapter 7. Volume 1. Executive Summary and methodology. Final report.** D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA (USA). 11 Jun 1990. 123p. Source: NTIS, PC A06/MF A01.

See also Volume 2, PB–90-240326; Also available in set of 3 reports PC E99/MF E99, PB–90-240300.

The report was prepared by D'Appolonia Consulting Engineers, Inc. (D'Appolonia) for the Office of Surface Mining Reclamation and Enforcement (OSM) to assess the probable impacts on coal production costs of numerous discretionary issues involved in drafting the permanent regulations for implementation of the Surface Mining Control and Reclamation Act of 1977 (the Act). The results of the engineering cost study were used directly in OSM's Regulatory Analysis (RA) developed in compliance with Executive Order 12044. The final RA was published in March 1979 and is available from the OSM. The report details those analyses conducted by D'Appolonia and used in the RA. The results of the study are not meant to reflect the complete cost or economic impact of the Act or the resulting OSM regulations. The results do provide a basis for evaluating the relative impact of the various alternatives considered by OSM during development of the permanent regulatory program. The discretionary issues analyzed in the report pertain to both surface and underground mining activities. The volume presents the general methods of approach and final results of the study, while Volumes II and III present the individual analyses of each issue for surface and underground mines, respectively.

46482 (PB–90-240326/XAB) **Cost impact of discretionary alternatives. OSM Permanent Regulations 30 CFR, Chapter 7. Volume 2. Surface mining issues. Final report.** D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA (USA). Jul 1990. 200p. Source: NTIS, PC A09/MF A02.

See also Volume 1, PB–90-240318 and Volume 3, PB–90-240334; Also available in set of 3 reports PC E99/MF E99, PB–90-240300.

Volume II of the report presents the analysis of each of the discretionary issues and alternatives which were considered in detail in assessing the economic impact of compliance costs. To develop the incremental costs associated with compliance, each alternative considered was analyzed in detail relative to the requirements which would be imposed on each model mine. Of the 41 discretionary issues originally defined by OSM for the study, all of them were not considered in detail for surface mining. As discussed in Volume I, some of the issues were judged to lead to insignificant compliance costs while others are applicable only to underground mines. The descriptions of the model surface mines given in Volume I are repeated in Chapter 2.0 of the volume. The analyses of each issue are given in Chapter 3.0. For completeness, all issues are discussed in Chapter 3.0 even though each issue is not considered in detail. Where issues apply to underground mines, it is so noted with reference to Volume III where the detailed analyses of underground mining issues are discussed.

46483 (PB–90-240334/XAB) **Cost impact of discretionary alternatives. OSM Permanent Regulations 30 CFR, Chapter 7. Volume 3. Underground mining issues. Final report.** D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA (USA). 13 Jun 1990. 154p. Source: NTIS, PC A08/MF A01.

See also Volume 2, PB–90-240326; Also available in set of 3 reports PC E99/MF E99, PB–90-240300.

Volume III of the report presents the analysis of each of the discretionary policy alternatives which were considered in detail in assessing the economic impact of compliance costs. To develop the incremental costs associated with compliance, each policy alternative considered in detail was analyzed relative to the requirements which would be imposed on each model mine. Of the 41 discretionary policy issues defined by OSM for the study, all of them were not considered in detail for underground mining. As discussed in Volume I, some of the issues were judged to lead to insignificant compliance costs while others are applicable only to surface mines. The descriptions of the model underground mines given in Volume I are repeated in Chapter 2.0 of the volume. The analyses of each policy issue are given in Chapter 3.0. For completeness, all issues are discussed in Chapter 3.0 even though it was not considered in detail. Where issues apply to surface mines, it is so noted with reference to Volume II where the detailed analyses of surface mining issues are discussed.

02 PETROLEUM

0202 Reserves, Geology, and Exploration

46484 (DOE/BC/14434–1) **Depositional sequence analysis and sedimentologic modeling for improved prediction of Pennsylvanian reservoirs: Quarterly report, April–June 1990.** Watney, W.L. Kansas Geological Survey, Lawrence, KS (USA). Sep 1990. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-90BC14434. Order Number DE90016733. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objectives of this research are to: (1) assist operators in locating and producing petroleum not currently under development because of technological problems or the inability to identify details of reservoir compartmentalization, (2) to decrease risk in field development, and (3) accelerate the retrieval and analysis of baseline geoscience information for initial reservoir description. The interdisciplinary data sought in this research will be used to resolve specific problems in correlation of strata and to establish the mechanisms responsible for the Upper Pennsylvanian stratigraphic architecture in the Midcontinent. The data will better constrain ancillary problems related to the validation of depositional sequence and subsequence correlation, subsidence patterns, sedimentation rates, sea-level changes, and the relationship of sedimentary sequences to basement terrains. The geoscientific information, including data from field studies, surface and near-surface reservoir analogues, and regional database development, will also be used for development of geologic computer process-based simulation models tailored to specific depositional sequences for use in improving prediction of reservoir characteristics. Progress is briefly described. 3 figs.

46485 (DOE/BC/14473–3) **Demonstration of high-resolution inverse VSP for reservoir characterization applications: Quarterly report for April–June 1990.** Parra, J.O. Southwest Research Inst., San Antonio, TX (USA). Sep 1990. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-89BC14473. Order Number DE90016736. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this project is the demonstration of inverse vertical seismic profiling measurements using new experimental field instrumentation capable of providing at least an order of magnitude improvement in the resolution of structural details in comparison

with conventional seismic images. This two-year project will entail instrumentation tests under controlled field conditions during the first year followed by full-scale field demonstration tests in a representative oil-bearing reservoir formation during the second year. In this third quarter, the wax-melt borehole seismic sensor package containing acceleration sensors was designed, constructed, and tested in laboratory and field experiments to evaluate this novel reversible rigid-coupling method. 2 figs.

46486 (DOE/BC/14666–1) **Development of luminescent bacteria as tracers for geological reservoir characterization: Quarterly report for April–June 1990.** King, J.W. Hardin-Simmons Univ., Abilene, TX (USA). Fairleigh Dickinson Labs. Sep 1990. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-90BC14666. Order Number DE90016734. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research project resulted from recognizing the problem of being unable to accurately distinguish communication between wells in producing oil zones which may or may not be continuous. Bioluminescent bacteria are being developed for use as tracers in reservoir characterization. A pure culture of Photobacterium phosphoreum is being studied in the laboratory for accurate monitoring schemes. A search of the literature and communications with marine microbiologists indicate that bioluminescent bacteria can be easily studied in vitro.

46487 (EUR–12446) **Diagenesis and porous system in Danish Zechstein carbonate reservoirs: Final report.** Frykman, P.; Stentoft, N.; Rasmussen, K.L.; Christensen, O.W.; Andersen, P.V.; Jacobsen, F.L. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). 1989. 173p. Sponsored by Commission of the European Communities. Contract EN3C/0030-DK (MB). Source: NTIS (US Sales Only), PC A08/MF A01; Office for Official Publications of the European Communities 2, rue Mercier L-2985 Luxembourg; Price ECU 13.75.

This study of production characteristics of the Zechstein carbonates has included several topics: sedimentology and diagenesis; porosity types and textural classification; log-analysis of carbonate sequences; pore geometry; and chemical analysis. The study was performed in order to clarify the diagenetic processes involved in porosity evolution including a timing of the diagenetic events. The textural classification and pore geometry investigations aimed at quantification of pore network parameters relevant to production characteristics. Pore geometry has been described qualitatively and quantified by use of image analysis and has been correlated to other flow-relevant parameters. Ultrasonic P-velocities (1 MHz) have been measured successfully in the laboratory on dolomite, anhydrite and halite plugs. Correlations of velocity to porosity and between porosity and acoustic impedance are discussed. 57 refs., 58 figs., 9 tabs.

46488 (EUR–12534) **Interpretation of borehole logging data by use of theoretical models for the nuclear probes used: Final report.** Olgaard, P.L.; Petersen, R. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. [1990]. 56p. Sponsored by Commission of the European Communities. Contract EN 3C 0009-DK(B). Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier L-2985 Luxembourg; Price ECU 5.

Borehole logging is used extensively in prospecting for oil and gas. Various types of nuclear borehole logging tools are used. Of these the neutron porosity tool, the gamma density tool, the pulsed-neutron, capture-gamma tool and the natural gamma tools are the tools most frequently used in nuclear borehole logging and only these four tools were considered in this project. In the usual interpretation of nuclear logs it is assumed that the signal obtained by a given tool type is uniquely related to a relevant formation property such as water/oil volume fraction, bulk density or neutron absorption. By use of an empirical or semi-empirical calibration curve or algorithm which gives the relation between the tool signal and the formation property, the latter can be determined. Usually the tool signal is not determined by just one, but by several formation properties. The aim of the research project was to develop an interpretation method which takes into account this multi-property dependence. The idea behind the project, used to achieve this aim, was the following. 19 refs., 18 figs., 1 tab.

46489 (GAO/RCED–90-16) **Naval Petroleum Reserve No. 1: Work still needed to improve accuracy of reserve estimates.** Perkin-Elmer Corp., Norwalk, CT (USA). Jan 1990. 41p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

For several years, the administration has proposed selling the government's ownership interest in the Naval Petroleum Reserves, arguing that it would help reduce the federal budget deficit. The administration's latest proposal calls for the sale of reserves in fiscal year 1990. DOE estimates that if the reserves are sold in 1990, proceeds would amount to about $3.4 billion. The Naval Petroleum Reserve at Elk Hills, California, is the largest of the reserves. This report has reviewed and analyzed the new reserve data and found that DOE's reserve estimates for Elk Hills are still neither accurate nor up-to-date.

46490 (GGU-R–142) **A pilot seismo-stratigraphic study on the West Greenland continental shelf.** Chalmers, J.A. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). 1989. 46p. Order Number DE90518683. Source: NTIS (US Sales Only), PC A03/MF A01.

Seismo-stratigraphic interpretation of seismic sections dating from the mid-1970s has disclosed the existence of four megasequences of sediments, the oldest of which has not previously been reported from West Greenland. The basins containing these sediments developed as a series of coalescing half graben, in which the main site of tectonic activity changed with time. A structural closure of sufficient size to contain interesting quantities of hydrocarbons, given suitable source rocks, reservoir and seal, is identified. The study has shown that the evaluation of the West Greenland Basin during the 1970s was inadequate, and that abandonment of exploration by the petroleum industry may have been premature. (author) 34 refs.

46491 (IFP–37-626) **Sonic and ultrasonic elastic wave velocity and attenuation in rocks under confining pressure.** Lucet, N. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). Nov 1989. 279p. (In French). Order Number DE90518448. Source: NTIS (US Sales Only), PC A13/MF A01.

A presentation of resonant bar technique, permitting the measurement of acoustic properties of rocks under confining pressure, and a critical analysis of the method are reported in the first part of this thesis. It is shown, in the second part, that intrinsic sonic attenuation of non-shaly water-saturated rock samples is very low. These sonic measurements are compared to ultrasonic measurements performed on the same rocks. High apparent ultrasonic attenuation values are explained by density heterogeneities and shear wave birefringence. Experimental velocity dispersion between the two frequency ranges can sometimes be fitted to viscoelastic models such as Constant Q or Nearly constant Q models. Discrepancies with these rules can often be related to the presence of heterogeneities.

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Refer also to citation(s) 46486, 46623

46492 (DOE/BC/14659–1) **Characterization of non-Darcy multiphase flow in petroleum bearing formations: Quarterly report for April–June 1990.** Evans, R.D.; Civan, F. Oklahoma Univ., Norman, OK (USA). School of Petroleum and Geological Engineering. Sep 1990. 4p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-90BC14659. Order Number DE90016735. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Short communication. RESERVOIR ROCK/multiphase flow; PROGRESS REPORT; PETROLEUM; FRACTURES

46493 (DOE/METC–90/4100) **Simulation study of the carbon dioxide enhanced oil recovery pilot test in the Griffithsville Field, Lincoln County, West Virginia.** Brummert, A.C. USDOE Morgantown Energy Technology Center, WV (USA). Sep 1990. 27p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90009670. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A carbon dioxide pilot test was conducted in the Griffithsville Field, Lincoln County, West Virginia, on a 90-acre tract containing

nine 10-acre, normal, five-spot patterns arranged in a 3 x 3 matrix. This post-flood simulation study evaluates the initial pressure buildup phase of water injection, the carbon dioxide injection phase, and the chase water injection phase. Core data, geophysical well logs, fluid property data, well test data, and injection/production histories were used in setting up the data input record for the reservoir simulator. The reservoir simulator was IMEX, a four-component, black-oil reservoir simulator. 23 refs., 15 figs., 3 tabs.

46494 (LA-UR-90-2774) **An expert system for screening enhanced oil recovery methods.** Parkinson, W.J. (Los Alamos National Lab., NM (USA)); Luger, G.F.; Bretz, R.E.; Osowski, J.J. Los Alamos National Lab., NM (USA). [1990]. 38p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-900828–7: Summer national meeting of the American Institute of Chemical Engineers, San Diego, CA (USA), 19-22 Aug 1990). Order Number DE90016494. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper demonstrates how a small expert system can be written with inexpensive shells (CLIPS and EXSHELL) and run on inexpensive personal computers. CLIPS is a forward-chaining rule-based system written in the C language. Rules are entered in a LISP-like format. EXSHELL is a backward-chaining rule-based system written in the PROLOG language. These shells were used to write a small expert system, an expert assistant, which is used to help petroleum engineers screen possible enhanced oil recovery candidate processes. Though the final candidate process is selected on the basis of an economic evaluation, the expert assistant greatly reduces the amount of work involved. The system selects the optimal collection of paths to the solutions and is easily updated as new data become available. This paper also demonstrates the utility and ease of use of these inexpensive shells, compares the approach used by each, and demonstrates the relative advantages of forward-chaining versus backward-chaining for this problem. 11 refs.

46495 Summary results of CO_2 EOR field tests, 1972-1987. Brock, W.R. (Exxon Co., Houston, TX (USA)); Bryan, L.A. pp. 11-20 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Since the early 1970s, numerous presentations have been made and articles written about pilot tests and field-scale enhanced oil recovery projects using carbon dioxide (CO_2) as a solvent. This paper summarizes publicly available data on 30 projects. The use of CO_2 has grown significantly since the early-1980s, especially in the Permian Basin, as reliable supplies of CO_2 became more available. Today, even with depressed crude oil markets, the use of CO_2 continues to grow. The use of CO_2 in the Rocky Mountain region is increasing, primarily among those with prior CO_2 flooding experience in the Permian Basin. As the demand for CO_2 increases in the Rocky Mountains, so will the supply, and the same growth experienced in the Permian Basin should be seen. As with any major project in the oil industry, the enhanced recovery of oil requires thorough advance planning to determine the optimum EOR method. This summary of CO_2 projects is intended to provide a brief on each project, describe the reservoir parameters, and review the conclusions of the individual authors, in addition to providing a quick reference of available papers to which those interested may turn for greater detail. Since the use of CO_2 has been successfully tried in a wide range of reservoirs and under a variety of operating conditions, the application of CO_2 in Rocky Mountain reservoirs should be every bit as successful as it has been elsewhere.

46496 The Ford Geraldine Unit CO_2 flood: Update 1990. Pittaway, K.R.; Rosato, R.J. pp. 21-28 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The Ford Geraldine Unit (FGU) CO_2 flood is 130 miles (209 km) west of Midland, Texas. The miscible flood is a continuous slug CO_2 injection process, presently calling for a 30% total pore volume slug size followed by a brine post-flush. CO_2 injection started in February 1981, when the oil production rate from a staged waterflood had decreased to about 300 B/D (50 m^3/day). Production has increased to 1,500 B/D (250 m^3/day) since that time, and is expected to reach 2,000 B/D (320 m^3/day) in 1991. This paper will discuss the reservoir, the history of the flood, the collection and use of data, and the reservoir modeling that is a part of the FGU CO_2 flood.

46497 Compositional simulation of the Coyanosa Wolfcamp field gas cycling operation. Kim, J.S. (Mobil Exploration and Producing Services, Inc., Dallas, TX (USA)). pp. 29-38 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The Coyanosa Wolfcamp Field, located in Pecos County, Texas was discovered in September 1962. The reservoir rock is comprised of poorly sorted, coarse-grained heterogeneous conglomerates with thinly interbedding shaly limestones. The dew point pressure of the Gas Unit reservoir (representing about 80% of the Coyanosa Wolfcamp Field pore volume) was 6,179 psia at a reservoir temperature of 175°F. The initial reservoir pressure was 6,700 psia. Mobil initiated a gas cycling operation in August 1964. The condensate yield has declined steadily during the lean gas cycling operation. A compositional simulation study was undertaken to simulate complex mass transfer and composition changes. The study's objectives were to estimate the remaining condensate reserves and to determine an efficient depletion scheme including an optimum reservoir blowdown timing. After matching the past 23 years of the production history, the model was then used to predict future performance under the various operating scenarios. The sensitivity of liquid recovery to pressure, rate and degree of cycling was investigated. Depletion plans such as added compression, partial cycling and immediate blowdown were evaluated to devise an optimal operation plan.

46498 Viscous fingering, gravity segregation, and reservoir heterogeneity in miscible displacements in vertical cross sections. Araktingi, U.G. (Chevron Oil Research Co., La Habra, CA (USA)); Orr, F.M. Jr. pp. 39-46 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract AC21-85MC22042 ;FG21-89MC26253. (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Combined effects of gravity segregation, viscous fingering and reservoir heterogeneity are examined in particle-tracking simulations of flow in vertical cross sections. Differences in model formulation from previous descriptions are reviewed briefly. The accuracy of the simulation representation of the physical flow mechanisms is tested. For homogeneous cross sections, simulator calculations are presented that illustrate the transition from flow in a single gravity-dominated tongue at low viscous to gravity ratio (N_{gr}) to flow dominated by viscous fingering at high values of N_{gr}. Quantitative accuracy of the simulator is tested against the experimental results of Pozzi and Blackwell. Simulation results agree with experimental results over wide ranges of mobility ratio, viscous to gravity ratio, and aspect ratio. Additional simulations also agree well with Stalkup's correlation of breakthrough recovery as a function of mobility ratio and N_{gr}. The validated simulator is then used to augment Stalkup's correlation with results for additional mobility ratios. In addition, plots are presented of recovery after breakthrough as a function of N_{gr} for several mobility ratios. The results confirm that in homogeneous porous media, better displacement performance is observed at high viscous to gravity ratio for any mobility ratio. For heterogeneous porous media, however, that conclusion must be qualified. Example simulation results show that for injection of light solvent into a layered reservoir with high permeability low in the reservoir, better displacement efficiency is observed at intermediate values of N_{gr} than at high or low values. If the high permeability is at the top of the reservoir, high N_{gr} is still preferred.

46499 Analytical consumption of breakthrough recovery for CO_2 floods in layered reservoirs. Pande, K.K. (Chevron Oil Field Research Co., La Habra, CA (USA)); Orr, F.M. Jr. pp. 47-58 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract AC21-85MC22042 ;FG21-89MC26253. (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The interaction of phase behavior, viscous crossflow, and reservoir heterogeneity is considered for the flow of CO_2-butane-decane mixtures in two-layer porous media. Phase behavior is represented by the Peng-Robinson equation of state. Oil recovery at breakthrough is calculated analytically for dispersion-free flow, with and without vertical equilibrium crossflow, for displacement pressures that span the range from immiscible to multicontact miscible to first-contact miscible displacements. Also reported are analytical calculations of the slope of the recovery curve after breakthrough. In addition, results of finite difference calculations of breakthrough recovery and recovery after breakthrough are given for the same systems. The calculations indicate that crossflow is generally beneficial, except when the ratio of layer permeabilities is low. Displacements that are multicontact miscible perform better than those that are immiscible or those that are first-contact miscible. The improvement results from two mechanisms: (1) transfer of some oil from the slow layer to the fast layer where it can be recovered more quickly, and (2) reduction of the total mobility of fluid in the fast layer by the formation of two phases as a result of mixing due to crossflow.

46500 Sensitivity to gridding of miscible flood predictions made with upstream differenced simulators. Stalkup, F.I. (ARCO Oil and Gas Co., Bakersfield, CA (USA)); Lo, L.L.; Dean, R.H. pp. 59-70 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper examines the sensitivity to gridding of first-contact miscible and three-component multicontact miscible condensing-gas drive predictions made with an upstream differenced simulator. These cross-section simulations are made for various reservoir descriptions and for models of increasing numbers of grid blocks. The largest models range from 5,000 to 24,000 grid blocks. The paper examines gridding sensitivity when the coefficients of convective terms are evaluated by the single-point upstream method, and it also examines the utility of two-point upstream weighting and selectivity refined initial gridding for moderating gridding sensitivity. These simulations show the following behavior. For some problems with single-point upstream weighting, ultimate recovery changes monotonically with an increasing number of grid blocks. The change in recovery with increasing grid blocks can either be a decrease or an increase depending on the particular reservoir description, although decreasing recovery was the most common behavior for the reservoir descriptions examined here. Two-point upstream weighting and selectively refined initial gridding reduced, but didn't eliminate, this sensitivity. Some predictions appear to converge almost linearly with grid size to approximately the same answer in the limit of zero grid block size (i.e., infinite grid blocks) when the problem is worked in different ways, e.g., single-point weighting, two-point weighting, selectively refined initial gridding. For one reservoir description, recoveries computed with and without physical diffusion/dispersion appear to be diverging with grid refinement.

46501 Dynamic effective relative permeabilities for cross-bedded flow units. Kasap, E. (Univ. of Texas, Austin (USA)); Lake, L.W. pp. 71-82 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This study describes an analytical method to generate effective relative permeabilities which account for an uneven displacement front in the direction normal to the main flow direction in viscously dominated flows. The procedure consists of discretizing the flow unit into subunits and homogenizing each subunit by calculating an effective permeability tensor which resolves cross-bedding and cross-bed orientation. Because of heavily laminated regions the effective permeability in each subunit is a tensor which has non-zero off-diagonal elements. Effective (pseudo) relative permeabilities are then generated analytically to account for differences in sweep between the subunits and for changing flow conditions during the displacement process. The analytical results obtained from the proposed procedure are validated by comparisons with the results of a finite element simulator which models permeability laminations explicitly. The comparison indicates that analytically generated effective relative permeabilities are valid, easy to implement and accurately account for detailed heterogeneities in numerical simulations. Furthermore, by using this method an overall vertical sweep efficiency in cross-bedded flow units can be estimated analytically as function of cross bedding angles, sizes, and local permeabilities as well as the mobility ratio.

46502 Mathematical simulation of phase behavior of natural multicomponent systems at high pressures using equation of state. Brusilovsky, A.I. pp. 83-94 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A new general cubic equation of state (EOS) for predicting phase behavior of natural multicomponent systems under pressure and temperature conditions conforming to the processes of reservoir engineering is suggested. Examples of the use of the equation for predicting volumetric behavior, fugacity, departures of enthalpy and entropy of single-component systems up to 100 MPa are given. The new EOS performs better than the Peng-Robinson (PR) equation in all cases tested. The values of interaction coefficients for the new EOS have been obtained on the base of experimental data of phase behavior for binary systems containing hydrogen sulfide, carbon dioxide, nitrogen and n-alkanes from methane to n-decane are given. The new effective method of calculations for critical pressure of fractions C_{5+} or C_{7+} group in reservoir fluids is suggested. The method under consideration is of great importance for successful simulation under pressure above 25 MPa. Proposed method can be used with any cubic EOS. Critical properties are presented for the PR and the New EOS. Mathematical simulation results of phase and volumetric behavior for natural multicomponent systems (in their number those containing hydrogen sulfide and carbon dioxide up to 35% mol.) are compared with the results of experimental investigations for the above systems under pressure up to 60 MPa. The effect of porous media on phase behavior for natural multicomponent systems is investigated. The results of mathematical simulation are described. The effects of capillary pressure on the dew- and bubble-point parameters are analyzed. A new calculation method for determining of minimum miscibility pressures (MMP) using an EOS is presented. The MMP predictions for sour real reservoir oils and different injection gases are presented.

46503 The effect of solvent viscosity on miscible flooding. O'Steen, B.L.; Huang, E.T.S. pp. 95-108 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Experimental results for tertiary miscible displacements in strongly water-wet Berea cores are presented. Floods with both continuous solvent and simultaneous solvent-water injection were studied at ambient conditions. Three solvent-oil systems are compared: heptane (0.4 cp) displacing mineral oil (6 cp), tagged heptane displacing heptane, and tagged mineral oil displacing an equal viscosity mineral oil (6 cp). Saturation profiles from microwave absorption measurements and production histories are presented. The experimental results show that the manner in which

residual oil is mobilized and propagated depends upon solvent-water injection ratio, oleic-water phase viscosity ratio and fractional flow hysteresis. Supporting mechanistic studies of these floods with a model incorporating both trapped and dendritic oleic phase saturations were also performed. These studies demonstrate that both trapped and dendritic fractions can be important in the modeling of miscible displacement in water-wet systems. They also suggest the need for trapped and dendritic saturations which depend on oleic phase viscosity as well as oleic phase saturation.

46504 Three-phase relative permeability of water-wet Berea. Oak, M.J. pp. 109-120 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Two-phase and three-phase relative permeabilities of water-wet Berea sandstone have been studied experimentally. Eight cases of saturation history have been investigated. About 1,800 data have been collected using the steady-state method: about half of them for two-phase flow and the other half for three-phase flow. The experimental results are compared with predictions by Stone's methods. Stone's predictions of three-phase oil relative permeability are unsatisfactory. The experimental data do not support the assumption that two-phase relative permeability data can be used to predict three-phase relative permeability with a similar saturation history. The data suggest that displacement of trapped oil by gas is an important factor affecting three-phase oil permeability. It is also suggested that there exists a critical oil phase saturation to initiate three-phase flow from water-oil two-phase flow, which can be different from that in the two-phase flow. The prediction methods fail to account for these factors.

46505 Three-phase gas/oil/brine relative permeabilities measured under carbon dioxide flooding conditions. Pope, G.A. (Univ. of Texas, Austin (USA)); Sepehrnoori, K.; Dria, D.E. pp. 121-132 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Steady-state three-phase gas-oil-brine relative permeabilities were measured in a carbonate core under carbon dioxide flooding conditions. The authors results show that the relative permeability of each phase depends only on the saturation of that phase, rather than on two saturations as many previous studies have concluded. All previously reported gas-oil-brine relative permeability studies have been conducted with low-pressure N_2 gas or air. In this work, carbon dioxide gas, oil, and brine were injected into a carbonate core at 160°F and 1,400 psia so that the phase behavior and flow would be similar to reservoir conditions. Their results show that there are significant differences between the three-phase gas-oil-brine relative permeabilities measured when the gas is CO_2 and the result of others when the gas was N_2.

46506 Mobilization of waterflood residual oil by gas injection for water-wet conditions. Billiotte, J. (Ecole des Mines de Paris (France)); Oren, P.E.; Pinczewski, W.V. pp. 133-146 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Two-dimensional glass micromodels were used to investigate the mechanisms by which waterflood residual oil is mobilized and recovered during tertiary gas flooding at quasi-static rates and strongly water wet conditions. Two three phase oil-water-gas systems were used in the displacement experiments. One system had a positive spreading coefficient, the other a negative spreading coefficient. Results for the two systems were compared to determine the differences in displacement mechanisms and oil recovery efficiency. In both systems the displacement proceeds by a double drainage mechanism where a gas-oil displacement is always associated with an oil-water displacement. The oil-water displacement leads to coalescence and reconnection of oil blobs. Oil recovery was significantly higher for the positive spreading system. The higher displacement efficiency resulted from flow through thin but continuous oil films which always separated the oil and water phases in the positive spreading system. The absence of oil films and the possibility of direct gas-water displacements reduced oil recovery for the negative spreading system.

46507 Miscible gas-flood-induced wettability alteration: Experimental observations and oil recovery implications. Yeh, S.W. (Chevron Oil Field Research Co., La Habra, CA (USA)); Ehrlich, R.; Emanuel, A.S. pp. 147-154 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The authors present visual cell and coreflood data pertaining to the influence of water saturation on miscible gas flood residual oil (water blocking). In visual cell studies they equilibrate miscible gases and oils at reservoir conditions with an intervening water phase. They find that the solvent-induced deposition of separated solids causes initially water-wet quartz surfaces to become oil-wet. A number of miscible coreflood displacements at high water saturation are considered, and the extent of water blocking determined for Berea sandstone and reservoir cores. Displacements of fluid systems showing wettability alteration and of refined oil systems with no wettability alteration are reported. They find that water blocking measurements with pure hydrocarbons overestimate miscible flood S_{or}, regardless of whether the porous medium is Berea sandstone, a reservoir sandstone, or a reservoir carbonate, and regardless of whether the flood is CO_2 or hydrocarbon miscible. They further find that water blocking is significantly more severe in Berea sandstone than in reservoir rock. They assert that measurements of water blocking using refined oil systems in Berea sandstone greatly overestimate water blocking in reservoirs, at least in part because refined oils cannot reproduce miscible flood induced wettability alteration.

46508 Displacement characteristics of nitrogen flooding vs. methane flooding in volatile oil reservoirs. Boersma, D.M. (Delft Univ. of Technology (Netherlands)); Hagoort, J. pp. 155-162 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A comparative study has been carried out of methane and nitrogen injection into a volatile oil reservoir. The study is based on the analysis of the phase behavior, compositional reservoir simulations and slim tube experiments. The main conclusions of the study are: (1) The minimum miscibility pressure for nitrogen and methane injection into volatile oil reservoirs is the same. This means that, under ideal dispersion-free conditions, the microscopic displacement efficiency for both processes, at pressures above the MMP, is 100%. (2) Under non-ideal conditions, displacements above the MMP can not achieve multiple contract-miscibility. Methane injection shows a better displacement efficiency than nitrogen. This is because of the more favorable phase behavior characteristics of methane-oil systems. (3) The concept of minimum multiple-contact miscibility pressure has little practical value as a screening parameter for EOR processes.

46509 Phase behavior, fluid properties, and displacement characteristics of Permian basin reservoir fluid-CO_2 systems. Creek, J.L. (Chevron Oil Field Research Co., La Habra, CA (USA)); Sheffield, J.M. pp. 163-174 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The formation of a CO_2 rich second liquid phase in mixtures of CO_2 and Permian Basin reservoir fluids is now well established. The purpose of this paper is to present the authors experimental

measurements of fluid properties in this Liquid-Liquid-Vapor (L1-L2-V) region and their effects on the displacement of Permian Basin crude oil samples with CO_2. They first present detailed measurements of phase volumes, viscosities, densities, and interfacial tensions for a Permian Basin - CO_2 reservoir fluid system. They describe how these properties change as the L1-L2-V region is traversed. The extent to which the Peng-Robinson equation of state is capable of modeling these properties is also discussed. They have observed that the unusual behavior in slim tube displacement tests at Permian Basin reservoir conditions correlates with the formation and properties of these phases. Conventional criteria defining Minimum Miscibility Pressure (for example, recovery at 1.2 pore volumes injected) are found to be unsatisfactory for these systems. They propose criteria based on maximum ultimate recovery and secondary observations that are more satisfactory.

46510 A study of the mechanisms of carbon dioxide flooding and applications to more efficient EOR projects. Haynes, S. Jr.; Alston, R.B. pp. 175-184 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The mechanism of carbon dioxide flooding at pressures below the minimum miscibility pressure (MMP) were studied using a numerical model of a slim tube to determine a means of increasing the efficiency of such floods. Results of these studies indicate that, in multiple contact flooding (MCF), the gas phase at the liquid-gas front approaches a constant composition denoting a bank of solvent approaching conditions of miscibility, but not achieving it because of the quantity of methane, nitrogen, and other light gases that overwhelms it. The ethane plus components (C_{2+}) composed approximately 5% of the reservoir gas phase. This constant compositional gas phase formed early in the flood and persisted throughout the flood until eventual gas breakthrough. A simulated low-temperature flash of the reservoir gas phase produced a solvent that contained more than 75% ethane and propane. Slugs of this solvent were used to produce miscible displacements with CO_2 gas at pressures 40% below the MMP. These findings were confirmed in further studies using fluids from several other reservoirs.

46511 The effect of microscopic heterogeneity on CO_2-foam mobility. Part 2. Mechanistic foam simulation. Chang, S.H. (New Mexico Institute of Mining and Technology, Socorro (USA)); Owusu, L.A.; French, S.B.; Kovarik, F.S. pp. 185-198 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A new foam coreflood apparatus was constructed and is being used to investigate CO_2/foam systems. Coreflood experiments were run with (1) simultaneous injection of CO_2 and brine, and (2) simultaneous injection of CO_2 and surfactant solution into Berea sandstone. The cores were initially saturated with brine. Pressure drop and effluent volumes were matched with the new foam-flow model, thus fixing physical correlation free parameters. A new correlation has been proposed for the relationship between gas mobility and gas fraction, interstitial gas velocity, surfactant concentration, and oil saturation. The two-dimensional, mechanistic, foam-flow-in-porous-media model is presented. Here, foam is generated by the following mechanisms; snap-off or lamella division, and leave-behind, all of which are included in the simulation. In addition, foam coalescence and trapping processes are incorporated in the simulator. The model can represent many of the mechanisms associated with high-permeability zone blockage, fluid diversion, and increased trapped oil recovery.

46512 Carbon dioxide foam with surfactants used below their critical micelle concentrations. Kuhlman, M.I.; Falls, A.H.; Hara, S.K.; Monger, T.G.; Borchardt, J.K. pp. 199-208 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

It is advantageous to use surfactants below their critical micelle concentrations [CMC] to reduce gas mobility throughout a reservoir. When used in reservoir brines below their CMCs, inexpensive anionic surfactants propagate through rock with little delay due to adsorption. Yet, gas mobility is reduced below that of a waterflood in either Surfactant-Water Alternating Gas (SWAG) or coinjection experiments. Moreover, oil recovery is higher than in processes without surfactant. In contrast, at concentrations above the CMC, surfactant adsorption is much higher and the injected surfactant concentration can be greatly delayed. In addition, CO_2 mobility can be reduced so far below that of a waterflood that reservoir injectivity suffers. Moreover, oil recovery can be reduced because oil is emulsified and its mobility is lowered. This type of foam is only useful for near wellbore fluid diversions.

46513 Change in apparent viscosity of CO_2-foam with rock permeability. Lee, H.O. (New Mexico Institute of Mining and Technology, Socorro (USA)); Heller, J.P.; Hoefer, A.M.W. pp. 223-230 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper summarizes new and previous high-pressure experiments measuring the mobility of CO_2-foam in porous rock of different permeabilities, ranging from less than a millidarcy to hundreds of millidarcies, and including both sandstones and carbonates. Foam mobility is defined here as the ratio of the combined flow rate per unit superficial area to the pressure drop required for simultaneous flow of dense CO_2 and brine/surfactant through the sample and can be expressed in units of millidarcies per centipoise. The measured results can also be expressed in terms of the apparent viscosity of the CO_2-foam, and they give a quantitative basis for the belief that this displacing fluid should be particularly effective in heterogeneous formations. From a macroscopic viewpoint, the CO_2-foam acts like a single fluid with a viscosity equal to the ratio of the rock's brine permeability to the measured mobility. The apparent viscosity depends on rock permeability in a nonlinear fashion, increasing from a minimum of about 2 centipoise for the tightest rocks to an apparent maximum of about 1,000 centipoise for Berea. Individual mobility measurements are made at steady-state conditions; this is justified by consideration of oil field operational constraints. The results of auxiliary experiments are given and the methods described. These include measurements of essential surfactant characteristics such as durability against coalescence of the dense CO_2 bubbles in brine/surfactant solution. Results are also given to show the influence of other factors on foam mobility, including surfactant concentration and type, flowing fraction of the dense gas, and overall rate.

46514 Mathematical models of foam flooding. Fisher, A.W.; Foulser, R.W.S.; Goodyear, S.G. pp. 231-240 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

In the flow of foam in unconsolidated porous media, it has been shown that the destruction of foam lamellae depends on the gas/surfactant solution flow rates, fluid mobilities, and rock capillary pressure. This paper examines this flow regime, which the authors call the coalescence regime, in more detail. They have found that all published data referring to foam flow in consolidated media are consistent with a generalization if Khatib's model. This new model is described in this paper. Two and three phase steady-state foam mobility models have been developed which exploit the dominant role of the foam coalescence mechanism. These models are based on published data for foam flow. The mobility models are then used in a finite difference, three phase, multi-component simulator. The simulator is applied to show that it can reproduce the generic transient foam behavior observed in core floods. Calculations are then used to examine some of the important issues that have to be considered when designing field applications of foam flooding.

46515 Long-distance propagation of foams. Hudgins, D.A.; Chung, T.H. pp. 241-248 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract FC22-83FE60149. (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A series of experiments was conducted to study foam generation and propagation over long distances through porous media. To simplify the problem, they were performed in a one-dimensional physical model consisting of a 30-ft [9.14-m]-long sand-packed slim tube. All experiments were conducted at reservoir condition of 2,000 psig (13.79 MPa) backpressure at 150°F (338.7 K). Alipal CD-128 surfactant was used as the foamer. WAG (water-alternating-gas) ratios and injection sequences were varied and found to have a profound effect upon the foam generation and propagation, with higher WAG ratios (more water) breaking down the foam and washing it out. In some cases, the foam became immobile or very slow-moving, while in other cases, it traveled with the gas front for great distances. Crude oil's presence in the porous media was very detrimental to foaming. For comparison, similar experiments in short Berea sandstone cores without oil failed to produce any evidence of foaming.

46516 Microvisual and coreflood studies of foam interactions with a light crude oil. Schramm, L.L.; Turta, A.T.; Novosad, J.J. pp. 249-258 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Foam stability in the presence of crude oil is an important characteristic affecting foamflood performance. In this work micro-visual observations were made to focus attention on the lamella-oil interactions between a light crude oil and commercial surfactants being considered for foam-flooding applications in Alberta. The surfactant produced a range of foam behavior from quite stable foam, with almost no foam-oil interactions, through quite unstable foams, into which the oil was extensively emulsified and imbibed, in agreement with phenomenological model predictions. The observations are consistent with mobility reduction factors (MRF) and incremental oil recoveries obtained in experiments with foams flowing in Berea sandstone cores (ambient temperature, low pressure) at residual oil saturation.

46517 Steam-foam pilot project at Dome-Tumbador, Midway Sunset field: Part 2. Mohammadi, S.S.; Tenzer, J.R. pp. 275-284 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A steam-foam pilot project was conducted in the Dome-Tumbador leases, Midway Sunset field. The pilot consistent of four inverted five-spot patterns with a confined producer covering 5.2 acres (2.1 ha). The injection phase lasted 3.7 years. During this period, steam-foam was generated by continuous injection of steam with NaCl, alpha olefin sodium sulfonate (AOS) and nitrogen. Incremental oil due to foam was 6.0% OOIP. The AOS use was approximately 5.3 lbs (2.4 kg) active matter per barrel of incremental oil. A heat distribution analysis using neutron and temperature logs from two observation wells showed that foam had improved areal and vertical sweeps. Finally, a comparison between in situ foam volumes in Midway Sunset and a similar project conducted by Shell in two Kern River pilots showed that the rate of foam propagation in Midway Sunset is about 4.5 times faster than in Kern River.

46518 Effects of endpoint saturations and relative permeability models on predicted steamflood performance. Kumar, M. (Chevron Oil Field Research Co., La Habra, CA (USA)); Do, T.N. pp. 285-298 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A comprehensive numerical study was conducted to quantify the effects of endpoint saturations and relative permeabilities on steamflood performance for a heavy oil reservoir. Results show that the region most important for performance prediction is the high-temperature, gas (vapor)-oil relative permeability near the residual oil saturation (S_{org}). Furthermore, gas-oil relative permeabilities should be measured at steam temperatures because gas displacement occurs at steam conditions. For the water-oil system, irreducible water saturation (S_{wir}) has a greater effect on performance than residual oil saturation to water (S_{orw}) and the effect of temperature-dependent endpoint saturations is small. The linear interpolation model (SPE 17369) for three-phase oil relative permeability is preferable over the Stone's II model because it more accurately predicts residual oil saturation to steam. Practical endpoint oil saturations are adequate for performance prediction because very low values of oil relative permeability do not significantly affect recovery calculations. A 15% change in S_{org}, S_{wir}, and S_{orw} resulted in a 26, 13, and 7% change in cumulative oil recovery, respectively.

46519 Steam circulation in horizontal wellbores. Best, D.A.; Lesage, R.P.; Arthur, J.E. pp. 299-312 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A model to evaluate heat losses, steam quality and pressure profiles during steam circulation in a wellbore has been developed. The model's unique ability to simulate countercurrent flow streams accounts for the interactions of heat transfer, fluid flow, phase changes, slippage between steam and water, and flow regime changes. It is based on the conservation equations of mass, momentum and energy. The energy conservation equations can account for heat transfer in a stagnant annular gas blanket as well as the transient heat loss to the overburden and the reservoir. The mixture densities and frictional pressure drops were evaluated from two phase flow correlations. The heat transfer from the flowing streams was calculated from overall heat transfer coefficients involving thermal resistances and film condensation/vaporization coefficients. The conservation equations were solved iteratively by the Newton-Raphson method. The development of this model arose from a need to determine the wellbore heat loss distribution during the warm-up phase in Mobil Oil Cananda's horizontal well at Cold Lake. Results from the model are verified with actual field data.

46520 Oil recovery mechanisms in fractured reservoirs during steam injection. Reis, J.C. (Univ. of Texas, Austin (USA)). pp. 313-320 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The recovery mechanisms for steam injection in naturally fractured reservoirs and the characteristic recovery times for these mechanisms are reviewed. Laboratory studies suggest that steam injection can recover as much as 50% more oil than waterflooding in fractured reservoirs. This recovery is essentially independent of oil gravity, making steam injection equally attractive in light or heavy oil fractured reservoirs. One of the most important incremental recovery mechanisms is the differential thermal expansion between the oil and the matrix pore volume. At high temperatures, chemical reactions within the matrix block can generate gases, which will displace oil. In matrix blocks containing organic carbon, additional oil can be generated. Oil can also be recovered during cyclic processes by dropping the pressure and flashing the water in the matrix blocks to steam. The effects of steam injection on capillary imbibition of water are less clear, although the reduced viscosity at the higher temperatures will speed the imbibition process. Other mechanisms like gravity drainage, solution gas drive, and distillation are thought to play a less important role in oil recovery. The characteristic expulsion times for each of these recovery

mechanisms are identified. Most of the oil in matrix blocks as large as 10 ft wide can be recovered within a few months.

46521 New methodology for the specification of solvent blends for miscible enriched gas drives. Sibbald, L.R. (Shell Canada Ltd., Toronto, Ontario (Canada)); Novosad, Z.; Costain, T.G. pp. 321-328 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Many EOR projects in Alberta rely on injection of enriched natural gas to displace oil left behind by primary or secondary operations. An important practical design requirement in such projects is to specify the blend of an expensive C_{2+} enriching stream (which varies in composition) and the dry gas that comprise the solvent so as to minimize the cost of the displacing fluid. In this paper the authors outline the derivation of a C_{2+}/dry gas blending correlation for a large Alberta miscible flood using a new methodology. Recent theoretical and laboratory apparatus developments lead to this improved method. The blending correlation used data from rising bubble apparatus (RBA) experiments. These tests allow fast, precise determinations of solvent/oil miscibility. Importantly, before this undertaking, the RBA test was shown to give the same results as the standard slim tube experiment for the system studied. This correspondence was anticipated as a consequence of previously developed theoretical concepts about the relevant mechanism of miscibility development. Proper description of this mechanism is crucial for the correct interpretation of miscibility experiments. Equation of state (EOS) multiple-contact flash calculations and EOS-based compositional simulation of the displacement process were used to analyze the development of miscibility for this system. This conceptual understanding formed the basis for the use of the recently developed RBA technique in generating the data for the presented blending correlation.

46522 A theoretical study of water-blocking in miscible flooding. Lake, L.W. (Univ. of Texas, Austin (USA)); Mueller, T. pp. 329-340 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Miscible displacement processes can leave a substantial amount of residual oil behind the displacement front. This phenomenon has two general causes: instabilities caused by local heterogeneities or viscous fingering, and water blocking. This paper describes a study of the latter. Numerous laboratory experiments have shown that the blocking of in place oil from the solvent by mobile water can be significant, especially under water-wet conditions and large water saturations. Despite this, studies performed on this subject have been limited to either simple correction functions in numerical simulations or microscopic models. To their knowledge no explicit theoretical model considers the macroscopic bypassing and subsequent interaction of the solvent stream with a trapped hydrocarbon phase. In this study the authors deal with CO_2 as the miscible solvent. A numerical model is used to calculate the mass flux between a flowing and a stagnant region separated by a water film. The model considers diffusion of solvent and diffusional extraction of oil accompanied by swelling or shrinking of the stagnant hydrocarbon phase. The various process parameters are presented by a set of dimensionless numbers which allow the problem to be scaled to any system size. They show that the conditions for the mobilization of water-trapped oil are determined essentially to be two numbers: the ratio of the stagnant water to oil volumes and the ratio of the solvent equilibrium constants at the phase boundaries. They apply the model to published laboratory miscible flood experiments. By using the water film thickness as a matching parameter, the measured residual oil data for different flood velocities are closely reproduced. Their results indicate that solvent diffusion and oil swelling mechanisms effectively account for trapped oil on the laboratory scale.

46523 Investigation of a cyclic countercurrent light-oil/CO_2 immiscible process. Hara, S.K.; Christman, P.G. pp. 341-352 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Most large, full scale CO_2 displacement processes are conducted under miscible, drive conditions. There is, however, continuing interest in using CO_2 to displace oil under huff and puff conditions and where first contact miscibility does not always exist. This paper presents the results of experiments designed to look at the cyclic countercurrent exchange of CO_2 with a light oil in diatomite core material. Under the conditions of these experiments and 700 psi the oil is not miscible with CO_2. The experiments, operated as CO_2 soaks, i.e. huff and puff, attained lower oil saturations than control countercurrent brine imbibition experiments. In these experiments the pressure was cycled which resulted in significant oil production after many cycles. Modeling efforts indicated that the rate and efficiency with which immiscible CO_2 contacted and displaced oil was limited by the rate of liquid phase diffusion of CO_2. To support this hypothesis, a CT scan experiment was conducted to measure the liquid phase diffusion coefficient in diatomite. This diffusion coefficient is consistent with the value used to match the experimentally observed oil production. These results are not limited to the study of CO_2 displacing oil from the diatomite formation; diffusion can be important for any process which uses CO_2. This mechanism is of interest for both miscible and immiscible CO_2 processes as well as in CO_2 augmented waterflooding. When the rate of diffusion is significant compared to the rate of flow, it can improve recovery efficiency by diminishing bypassing due to fractures or fingering, increasing the contacted portion of the reservoir.

46524 The feasibility of cyclic CO_2 injection for light-oil recovery. Thomas, G.A. (Louisiana State Univ., Baton Rouge (USA)); Monger, T.G. pp. 353-360 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper presents an extended data base on field implementation of cyclic CO_2 injection for light oil recovery which can be used to extend the authors basic understanding of this process, to define reservoir selection criteria, and to formulate operational guidelines. Over 100 single-well tests conducted in fourteen fields located in the states of Louisiana and Kentucky were analyzed. Approximately 80% of the projects were judged successful based on CO_2 utilizations of less than 3 Mscf/STB [540 std m^3/m^3]. Field performance trends were identified by correlating reservoir/operational parameters with successful test response. Most of the trends observed are consistent with documented laboratory and field experience. Reservoir and operational data correlations indicate that the mass of CO_2 injected is the best predictor of stimulated oil production rate and ultimate incremental oil recovery. Larger CO_2 slugs proportionally increase oil recovery; however, effective slug size is limited by treatment radius. Diverse reservoir types are amenable, but project costs are apt to be lower for shallow reservoirs. Other desirable reservoir characteristics are thick pay interval, mobile water or free gas saturation, and adequate drive mechanism. Operational guidelines for cyclic CO_2 injection addressed in this paper include: determining the maximum economic slug size, optimizing the soak period, applying back pressure during early production, and managing offset wells.

46525 An improved viscosity correlation for CO_2/reservoir oil systems. Lansangan, R.M. (New Mexico Institute of Mining and Technology, Socorro (USA)); Kovarik, F.S.; Taylor, M.; Smith, J.L. pp. 361-370 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper presents a correlation for predicting viscosities of single phase and equilibrium vapor (dense fluid) and liquid phases of CO_2/synthetic oil and CO_2/reservoir oil mixtures from experimental data obtained by the authors over the past couple of years. The viscosity, density, and composition database was obtained using a newly developed, oscillating quartz crystal viscometer which is described in the text. This new viscometer was developed to measure viscosities over a range of conditions from 90°F to 250°F and 1,000 psi to 5,000 psi. The experimental error in viscosity measurement was determined to be less than 5% over a range from 0.04 cp to 4.0 cp. The crystal viscometer has been integrated into a continuous phase equilibrium (or continuous-multiple-contact) apparatus, a dynamic flow experiment which now measures viscosities, densities, and compositions of up to two phases in near-equilibrium simultaneously and rapidly. Crude oils from west Texas, northeastern New Mexico, and the Middle East as well as several synthetic oils of varying complexity were used in the study. The Lohrenz, Bray, and Clark correlation was modified using the Corresponding States Principle coupled with new mixing rules to include mixtures with CO_2 concentrations of up to 98 mole%. A high temperature crude oil/lean gas system was also included in the database. The new correlation showed about a 70% improvement in average absolute deviation compared to the Lohrenz, Bray, and Clark correlation. The new correlation is expected to improve, in many cases, their capability to predict oil recovery performance both in the laboratory and in the field.

46526 Implications of water-alternate-gas injection for profile control and injectivity. Gorell, S.B. pp. 371-378 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Simulation results are presented which demonstrate that Water Alternate Gas (WAG) injection should not be expected to improve vertical distribution of solvent, relative to continuous slug injection, for tertiary processes in non-communicating layered systems. These results are explained by considering the way in which fluid mobilities within, and between, different layers vary with time. WAG injection reduces the effective mobility of fluids in the highest permeability layer compared with continuous injection. However, it also reduces the mobility of the fluids in all the other layers, which can actually increase the fraction of CO_2 entering the highest permeability layer with WAG. Profile control with WAG should not be expected whenever the effective fluid mobility during solvent injection is higher than during water injection. The effect of compressibility on follow-up water injectivity reductions are also considered. Reduced water injectivity can result from the high compressibility of CO_2 and the redistribution of pressure profiles when the injectant is changed from CO_2 to water. While this redistribution is occurring, the local injection pressure gradient, and therefore the injectivity, is lower than one would calculate if compressibility were ignored. Differences between pressure and rate constrained injection schemes and the effects of slug size are also discussed.

46527 Placement of gels in production wells. Liang, J. (New Mexico Institute of Mining and Technology, Socorro (USA)); Lee, R.L.; Seright, R.S. pp. 379-388 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

An analysis is developed using fractional flow concepts to determine the degree of penetration of gelants into oil-productive strata as well as into water-source zones. Variables examined include permeability contrast, oil/water viscosity ratio, initial oil saturations, relative permeability characteristics, and gelant properties. A near-wellbore simulator is developed to confirm predictions that are made using the theoretical model. This work demonstrates that gelants can penetrate to a significant degree into all open zones - not just those with high water saturations. The damage caused by gel in oil-productive zones will depend greatly on (1) the flow geometry (linear or radial); (2) hysteresis of water-oil relative permeability curves; (3) the extent to which gels disproportionately reduce relative permeability to water more than to oil; and (4) fluid saturations. The impact of each of these factors is discussed. Particular attention is paid to the behavior of gel treatments that reduce the relative permeability to water more than to oil. Induced changes in the relative permeability curves near a wellbore will not necessarily enhance oil recovery from a particular zone. Examples are provided to illustrate and contrast situations where gels are/are not expected to damage oil productivity. Cases considered include fractured and unfractured production wells and wells with and without water coning problems. The analysis provides an explanation for why some of the most successful applications of gels have occurred in fractured wells that are produced by bottom-water drive. With the right properties, gels could change the critical rate for water coning by four to five orders of magnitude.

46528 Effect of high shear rate on in-situ gelation of a xanthan/Cr(III) system. Jousset, F. (Univ. of Kansas, Lawrence (USA)); Green, D.W.; Willhite, G.P.; McCool, C.S. pp. 389-396 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Gel solutions were mixed in-line to give an injected solution concentration of 1,500 ppm xanthan and 50 ppm Cr(III). A 15 foot length of unconsolidated sand was used as the porous medium. The effect of high shear rates was examined by varying the frontal velocity from 12 to 120 ft/d. During each gel displacement, pressure drops across sub-sections of the sandpack were recorded as well as data on the effluent. In gel displacements conducted at linear velocities between 11 to 35 ft/d a high flow resistance developed at a specific location in the sandpacks confirming earlier work of Hejri et al. The build-up in flow resistance (in situ gelation) was accompanied by a reduced polymer concentration downstream of this location, which was inferred from reduced pressure drops and reduced effluent viscosity. The location of this region of high flow resistance was correlated linearly as a function of frontal velocity. Studies performed on effluent samples indicated that a large amount of Cr(III) and polymer were retained in the sandpacks. Moreover, the high flow resistances developed at a location where the age of the flowing solution was around 10 hours, corresponding approximately to the point where the viscosity starts to increase for this gel system. At frontal velocities of 83 and 118 ft/d no significant flow resistance developed in these sandpacks. The residence time was apparently too small and the shear rate too large for in situ gelation to occur. The results of the experiments indicate that in situ gelation is mainly controlled by the kinetics of the gelation reaction and gel/polymer retention.

46529 Acrylamide-polymer/chromium(III)-carboxylate gels for near wellbore matrix treatments. Sydansk, R.D. pp. 397-408 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Acrylamide-polymer/chromium(III)-carboxylate gels have been developed for application as total-shutoff treatments which are to be placed near wellbore in matrix reservoirs. Based on the present study, the authors have concluded that these gels can be applied to reservoirs having hostile conditions, including high salinity and elevated temperatures. The single-fluid aqueous gels are produced by crosslinking polyacrylamide (PA) polymer with a Cr^{III}-carboxylate-complex crosslinking agent. For both the low- and high-temperature versions of this gel technology, the following parameters were studied: (1) concentration, molecular weight, and hydrolysis level of the polymer, (2) crosslinker concentration, (3) temperature, and (4) salinity. The effects of each parameter on gelation rate and on gel strength, stability, durability, and effectiveness are discussed. Emphasis during the experimental program was placed on developing gels for application to high-temperature reservoirs. Results of the laboratory study demonstrated that: (1)

the gels are stable at temperatures up to at least 255°F, (2) pregel solutions can be injected into reservoir core material over at least the temperature range of 72°F to 255°F, and (3) the gels consistently promote permeability reductions on the order of 10^{-3} to 10^{-6}. One of the innovations that permits application of the gel technology to matrix reservoirs is the use of low-molecular-weight PA. Use of low-hydrolysis PA facilitates the application to high-temperature reservoirs. Adequate delayed gelation at elevated temperature results from exploiting the slow autohydrolysis of PA.

46530 A mathematical model of in-situ gelation of polyacrylamide by a redox process. Todd, B.J. (Univ. of Kansas, Lawrence (USA)); Willhite, G.P.; Green, D.W. pp. 409-420 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Permeability modification treatments are used to improve waterflood sweep efficiency in mature waterfloods. These treatments consist of injecting a polymer solution combined with a crosslinking agent into a water injection well. The viscous gelling solution preferentially enters high permeability, water-swept areas of the reservoir and plugs these channels, forcing subsequent water injection into new areas of the reservoir. Previous investigators had thought the permeability reduction mechanism resulted from a simple bulk gelation of the injected solution. However, displacement data by McCool and Marty show that flow resistance in their sandpacks developed before the polymer solution was capable of gelling in bulk. McCool hypothesized that the permeability reduction resulted from the porous medium filtering aggregates of chromium/polyacrylamide from the gelling solution, well before a true gel could form. This paper presents a new numerical model based on the filtration hypothesis. The model consists of a mass transport equation for ten species coupled with kinetic models of the gelation process and porous medium and filtration models from the literature. The model successfully matches five in situ gelation displacements conducted by Marty. Model formulation and simulation results are presented in this paper.

46531 Studies of the effects of crossflow and initiation time of a polymer gel treatment on oil recovery in a waterflood using a permeability modification simulator. Gao, H.W. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Chang, M.M.; Burchfield, T.E.; Tham, M.K. pp. 421-434 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract FC22-83FE60149. (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A three-dimensional, three-phase (oil, water, and gas) simulator was developed by incorporating an in situ gelation model into a black oil simulator (BOAST). Three-dimensional sensitivity runs were performed using a two-layer reservoir model with a horizontal permeability contrast of 10:1 to investigate the effect of vertical to horizontal permeability contrast (k_v/k_h = 0.1, 0.01, and 0.001) on incremental oil recovery and to determine the optimal time for initiation of a polymer gel treatment in a waterflood. Results showed that while polymer flooding gave the largest incremental oil recovery over waterflooding at the highest k_v/k_h ratio, gel treatment gave the largest incremental oil recovery at the lowest k_v/k_h ratio. For the cases studied, polymer flooding initially gave a greater increase in incremental oil recovery than did the gel treatment; however, in the reservoir of k_v/k_h = 0.001, the gel treatment eventually produced more incremental oil with less polymer consumption (2,970 lb vs. 145,000 lb). The optimal initiation time for a gel treatment in an injection well was the time around water breakthrough occurred. Applying a gel treatment in both injection and production wells at about the same time at or after water breakthrough resulted in an improvement in incremental oil recovery and cash flow over that of treating only an injection well. The improvement in oil production from a gel treatment either in an injection or a production well or in both wells decreased as the k_v/k_h ratio increased. Gel treatments are not as effective in reservoirs that have a high k_v/k_h ratio.

46532 The development of a probabilistic physical model for foam generation by snapoff in regular square grid network systems. Armitage, P.; Dawe, R.A. pp. 435-446 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper assesses the degree of influence snap-off, leading to either a bubble flowing or pore blocking mechanism, has on the pressure profiles and sweep efficiencies generated as a result of bubble production and foam propagation through regular square grid networks. A visual single pore model in which bubbles of known size can be generated leading to either of the two mechanisms was developed. New 2-D visual square grid networks have been developed in which different numbers (0,39,185) of these single pore bubble germination sites are incorporated as a fraction of the total number of sites available (800). In effect what has been created is a series of pre-determined, probabilistic physical models for bubble generation by snap-off. These models have been used in a series of systematic drainage displacements. These experiments have yielded quantitative information on how bubble production and the subsequent flowing bubbles or pore blocking can affect a foam's ability to control the mobility of the gas phase. These studies allow for a more competent evaluation of the importance of both of these mechanisms in improving the sweep efficiency.

46533 Surfactant flood process design for Loudon. Maerker, J.M. (Exxon Production Research Co., Houston, TX (USA)); Gale, W.W. pp. 447-462 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper describes design of the microemulsion process used in four progressively scaled (one to five-acre spacing) field pilot tests to assess Exxon's chemical-flood technology in the Loudon field. The microemulsion process based on synthetic surfactants was designed for the high-resident-salinity Loudon field using phase-behavior tests and corefloods in Berea and Loudon reservoir rock. The process has successfully recovered significant quantities of residual oil in one-acre pilots without the use of a cosurfactant, a cosolvent alcohol or a low-salinity preflush. Incorporation of polymer in the microemulsion was shown to minimize adverse mobility ratios in the oil-bank/microemulsion mixing zone, provide controllable microemulsion rheology and significantly increase oil recovery in a wide-model coreflood where effects of viscous fingering are observable. Larger microemulsion banks were necessary to propagate surfactant and maintain good oil recovery with lower permeabilities. Over the range of permeabilities represented by Loudon core plugs (50 to 100 md [0.05 to 0.1 μm^2]), oil recovery with a fixed bank size was found to correlate with logarithm of permeability for both Berea and Loudon rock. The utility of the correlations from 2-ft Berea corefloods in optimizing surfactant blend ratio, microemulsion salinity, drive-water salinity and bank size is described. Oil recovery was found to be fairly sensitive to microemulsion salinity, and small variations in this salinity could be compensated for by readjusting surfactant blend ratio. Most of the coreflood parameters and results, including microemulsion final-oil-saturation-distribution data, are included.

46534 Second Ripley surfactant flood pilot test. Reppert, T.R. (Exxon Production Research Co., Houston, TX (USA)); Bragg, J.R.; Maer, N.K. Jr.; Gale, W.W.; Wilkinson, J.R.; Snow, T.M. pp. 463-474 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A second successful surfactant flood pilot test was conducted by Exxon on the Lewis Ripley lease in a watered-out portion of the Weiler sand, Loudon Field, Illinois. The salinity-tolerant, micellar/polymer process tested in this pilot incorporated several process

modifications developed since a previous test was conducted in 1980. These changes included using a 25% smaller microemulsion bank size and addition of formaldehyde to injected fluids to inhibit bacterial degradation of biopolymer. The pilot was performed in a single, 0.71-acre (2,873 m^2), 5-spot operated to approximate a confined pattern. Extensive data on flood performance were obtained from a comprehensive pilot monitoring program, including use of fluid tracers, observation wells, and post-test cores. Approximately 68% of the waterflood residual oil present in the test pattern was recovered. This actually exceeded the oil recovery achieved in the first pilot, despite using a smaller microemulsion bank. Improved mobility control and lower surfactant retention contributed to enhancing process performance. Formaldehyde was effectively transported and prevented bacterial degradation of biopolymer. It appears to be an effective biocide for use in subsequent surfactant flooding operations at Loudon. During the pilot, an inexpensive and efficient method was developed to separate produced oil-water-surfactant emulsions. While all test objectives were met, the effect of well spacing on oil recovery and chemical transport was not addressed.

46535 The low-tension polymer flood approach to cost-effective chemical EOR. Kalpakci, B.; Arf, T.G.; Barker, J.W.; Krupa, A.S.; Morgan, J.C.; Neira, R.D. pp. 475-488 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The Low Tension Polymer Flood approach addresses the two EOR problems of cost and control. Coinjection of low concentration surfactant and a biopolymer, followed by a further mobility control buffer, leads to much reduced overall chemical consumption, even in relatively high clay content rock. Though the optimum chemical injection period is more prolonged, the oil recovery timescale is not unduly prolonged. The LTPF process moves chemical flooding surfactant a long way toward being a simple, low-level waterflood additive process, attractive for field operations. It uses surfactant-polymer interactions as an advantage rather than coping with them as a problem. The chemical system describes is based on a scleroglucan biopolymer (500-750 ppm) plus surfactant mixture (3,000 ppm total surfactant). No cosolvent is used. This system was developed specifically for use with high salinity injection water (seawater) in a high temperature reservoir. The essential phase behavior description is given, together with other physical parameters and detailed coreflood performance. Finally, the authors discuss the computer simulation approach used to predict reservoir performance and the results obtained.

46536 Imbibition of surfactant solutions. Keijzer, P.P.M. (Koninklijke/Shell Lab., Amsterdam (Netherlands)); de Vries, A.S. pp. 489-494 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The goal of dilute surfactant flooding is to reduce the interfacial tension of the oil/water system to very low values in order to release the residual oil. The question then arise whether oil that would normally be produced by imbibition is lost as a result of such flooding; since the surfactant decreases or eliminates the capillary forces that underlie imbibition. To study the imbibition behavior of surfactant solutions, the authors first focused on miscible-fluid systems. Both theoretically and experimentally they have shown that miscible fluids can indeed be imbibed, depending on the affinity of the different fluids for the solid. These effects persist only as long as equilibrium (complete mixing) has not been attained. A similar behavior is expected for low-tension immiscible fluid systems. They present experimental results showing that indeed the (equilibrium) interfacial tension between model oils and surfactant solutions is not the driving force behind imbibition. For the surfactant systems studied, the conclusion is that lowering the interfacial tension has some effect on the imbibition rate but no effect on ultimate recovery.

46537 Use of mixed surfactants to generate foams for mobility control in chemical flooding. Llave, F.M. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Olsen, D.K. pp. 495-506 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract FC22-83FE60149. (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The authors investigated an enhanced oil recovery (EOR) process involves the injection of alternate slugs (or simultaneous injection) of gas and surfactant solution as drive fluids behind an active surfactant slug front as an alternative to the use of polymers to eliminate unfavorable surfactant-polymer interactions. Experiments showed that using alternate slug cycles of 0.10 PV of mixed surfactant formulations as foaming agents and 0.10 PV of nitrogen gas resulted in significant differential pressures (as much as 27 times higher) across a core. The differential pressures generated by injecting mixed surfactant formulation and nitrogen gas were significantly greater than when using the (individual) component commercial surfactants and gas alone, even at concentrations less than 0.1 wt% active surfactant. The mixed surfactant formulations were stable in the presence of oil, exhibiting comparable or better stability than the foams generated using the individual surfactants. Results indicate that the addition of another surfactant such as an amine oxide to an anionic foaming system has a positive synergistic effect by improving the foam generation behavior of the formulation. Steady-state experiments were conducted to determine the effect of foam flow rate on mobility reduction, and coreflood oil displacement experiments were performed to compare various injection modes and oil recovery efficiencies. Results showed that the generation and propagation of a foam front behind a low-concentration surfactant slug contributed to a significant increase in oil recovery.

46538 Design of a novel flooding system for an oil-wet central Texas carbonate reservoir. Olsen, D.K. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Hicks, M.D.; Sinnokrot, A.A.; Sweigart, C.N.; Hurd, B.G. pp. 507-516 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Alkaline-surfactant-polymer flooding (ASP) as a method for oil recovery has traditionally been applied to sandstone reservoirs. This paper describes the first application of ASP technology with wettability alteration in a carbonate reservoir and compares laboratory performance of alternate chemical flooding processes. The oil-wet Cretaceous Upper Edwards reservoir, located in Central Texas, has characteristics generally favorable for chemical flooding. The reservoir has low brine salinity, low temperature, moderate oil viscosity, high residual oil saturation, and a diverse carbonate lithology without anhydrite or gypsum. This reservoir targeted for EOR, is currently produced by a strong, natural water drive from wells on a 2-acre spacing. Extensive reservoir characterization has been performed to establish the extent of the resource. A laboratory study was conducted to compare alternative EOR processes for individual geologic zones identified by describing and subdividing the reservoir. Coreflood experiments using fresh Upper Edwards reservoir core have given post-waterflood oil recoveries of 45.3%, 10.0%, and 11.6% from small, low-concentration slugs of alkaline-surfactant-polymer, alkaline-polymer, and polymer formulations, respectively. These laboratory evaluations have shown that ASP formulations of sodium tripolyphosphate and sodium carbonate along with a low concentration of petroleum sulfonate maintain interfacial activity upon extensive dilution with reservoir brine and give significantly better oil recovery than alkaline-polymer or polymer formulations. The results indicate that a cost effective alkaline-surfactant-polymer process can be designed for application in a carbonate reservoir.

46539 A full-field numerical modeling study for the Ford Geraldine unit CO_2 flood. Lee, K.H.; El-Saleh, M.M. pp. 517-528

of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper describes a full field numerical modeling study of the on-going Ford Geraldine Unit CO_2 flood. A three-dimensional, miscible-type simulator was used to simulate the project area, which covers 3,850 acres and includes 212 wells. The numerical model was calibrated by matching rates, cumulative production, and pressure history, both field-wide and for individual wells. The full field model offers the following advantages over a unit or symmetric element model: (1) proper description of inter-well interference; (2) honoring the production/injection and workover histories of the individual wells; (3) preservation of the reservoir heterogeneity; and (4) no scale-up problems or assumptions. This paper will briefly describe the simulator and the technique used in the history matching. The effects of adjusting various parameters will be discussed, and the history match for full field and individual wells will be presented. After satisfactory history matching results were obtained, the model is being used to assist in the Unit CO_2 flood operation. Examples will be discussed demonstrating the importance of the simulator in monitoring and operating the flood.

46540 Reservoir surveillance impacts management of the Judy Creek hydrocarbon miscible flood. Pritchard, D.W.L. (Esso Resources Canada Ltd., Calgary, Alberta (Canada)); Georgi, D.T.; Hemingson, P.; Okazawa, T. pp. 529-540 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Gravity segregation between water and a hydrocarbon based solvent during miscible flooding has been observed at the Judy Creek Beaverhill Lake (BHL) A Pool tertiary flood. The solvent override results in bypassing of potential miscible reserves and decreases ultimate oil recovery. An effort to improve overall pool economics through maximizing oil recovery and more efficient solvent utility was sought. A vertical sweep pilot was undertaken to identify optimum pattern sizes by defining the shape and size of the solvent-water comingled region in the reservoir. It was found that the gravity segregation model defined by Stone was representative of the solvent-water comingled zone. A reduction in pattern size was seen to improve tertiary oil recovery levels. This has bolstered a pattern reconfiguration scheme to maximize ultimate oil recovery from the field.

46541 A case history of the Hanford San Andres miscible CO_2 project. Merritt, M.B.; Groce, J.F. pp. 541-548 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A full scale miscible CO_2 project was implemented in the Hanford (San Andres) Unit, Gaines County, Texas. The Hanford (San Andres) Field was discovered in 1977 and unitized in 1984 with both water and CO_2 injection planned. Water injection began in June, 1985 and CO_2 injection began in July, 1986. Unique aspects of the Hanford CO_2 project are: (1) CO_2 injection began only one year after initiation of water injection, (2) the unit is operated by an independent operator, (3) being recently discovered, the field has an abundance of modern logs, core data and pressure data available, and (4) a successful technique for correcting injection profiles was developed. The design, development, surveillance and performance of the project are discussed.

46542 Design, operation, and evaluation of a surfactant/polymer field pilot test. Holley, S.M.; Cayias, J.L. pp. 549-556 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Oryx Energy Company evaluated the design and operation of a low tension surfactant polymer pilot in the McCleskey sandstone of the Ranger Field in Eastland County, Texas. The test was performed in a watered out area developed on 40 acre (16.2 ha) spacing chosen because of its suitability for a surfactant-polymer process: primarily good reservoir permeability, availability of fresh water and high residual oil saturations. The major disadvantages were potential lack of pattern confinement and a salinity contrast due to the injection of fresh water. The purpose of the test was to determine the applicability of the technology and its implementation. The pilot was successful, based on both monitored results and produced oil, but it did not achieve its design objectives due to reservoir heterogeneity and reduced sweep efficiency. The successful propagation of chemical fronts and recovery of oil within the pilot area demonstrated that in this and similar reservoirs, surfactant flooding is capable of recovering tertiary oil in significant quantities on large areal spacing. This paper discusses the design, operation and evaluation of the field project and includes considerations for the successful implementation of the technology.

46543 A comparison of 31 Minnelusa polymer floods with 24 Minnelusa waterfloods. Hochanadel, S.M.; Lunceford, M.L.; Farmer, C.W. pp. 557-566 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The Minnelusa formation in Wyoming's Powder River Basin exhibits high permeability variations and adverse mobility ratios. Polymer augmented waterflooding has been the chosen technology to overcome these conditions for the past 15 years. The idea is to first unify the permeability distribution by injecting cationic polymer, followed by anionic polymer and aluminum citrate crosslinker. Then straight anionic polymer is injected for mobility control. This paper compares the results of 31 Minnelusa polymer floods with 24 Minnelusa waterfloods. The paper has two parts. The first part compares oil recoveries, injection volumes, flood lives, and water productions of the two population groups at various recovery efficiency cutoffs. At equal oil recoveries, the polymer floods inject less water, produce less water and recover the oil quicker than the waterfloods. The second part of the paper determines the economics of a typical polymer flood. The cumulative injection and the cumulative oil production of each field are plotted for both the waterfloods and the polymer floods. The points are curve-fitted to yield an equation which predicts oil recovery versus injection in dimensionless form. The equation of each group is applied to the same generic Minnelusa reservoir at a fixed injection rate to yield oil production in time-rate format. Economics are run based on these two production functions. Results show the polymer flood is economic and recovers an additional 7.5% OOIP over the waterflood. The polymer plus equipment cost is less than $2.00 per incremental barrel of oil.

46544 Polymer retention in porous media. Huh, C. (Exxon Production Research Co., Houston, TX (USA)); Lange, E.A.; Cannella, W.J. pp. 567-586 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Retention of a polymer in reservoir rock is examined theoretically and experimentally. In the theoretical part, a pore-level description of mechanical entrapment of a polymer in a model porous medium is developed, which shows that the trapping rate is proportional to the flux of polymer, and decreases almost linearly with the amount of trapped polymer until the maximum retention is reached. The maximum retention increases with increasing polymer concentration, and also with increasing flow velocity. The dynamics of polymer trapping indicates that if a polymer has a good solvency in water, it has less tendency to be trapped; but if a polymer has a high intramolecular permeability, it will have a high tendency for trapping. Based on the pore-level considerations, a phenomenological polymer retention model is proposed that accounts for both the

adsorption of polymer molecules on rock surfaces and the mechanical entrapment in pore matrices. An analytical solution for flow of a single-phase polymer solution in a core is obtained to interpret retention data from laboratory corefloods. In the experimental part, the retention of xanthan biopolymers from semi-dilute solutions flowing in a sandstone core is measured as a function of polymer concentration, flow velocity, and permeability of rock. The proposed retention model is shown to adequately represent two characteristic features of typical polymer effluent profiles from corefloods, that is, the frontal delay and the gradual approach to feed concentration. Treating retention with adsorption alone generally fails to describe these features. The effects of dispersion and the commonly-encountered, high accumulation of polymer near the core face are also examined by analyzing the coreflood effluent data with a finite-difference numerical solution of the above linear flow problem.

46545 Co-deployment of surfactant/polymer and miscible gas enhanced oil recovery processes: A simulation study. Barker, J.W. pp. 587-602 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A reservoir simulator capable of modeling both surfactant/polymer flooding and gas displacement processes (immiscible or miscible) is described. Novel extensions to existing phase behavior and relative permeability models are used to represent interactions between the two processes. Results are presented quantifying the possibilities for combined chemical and miscible EOR.

46546 Thermal stability of scleroglucan at realistic reservoir conditions. Kalpakci, B.; Jeans, Y.T.; Magri, N.F.; Padolewski, J.P. pp. 603-614 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Thermal stabilities of scleroglucan and two xanthans were determined at 93, 100, and 105°C with and without additives. Aging times varied from 280 to 720 days. The polymers were dissolved in 30,000 ppm TDS seawater with an adjusted pH from 4.5 to 7.5. Scleroglucan exhibited excellent thermal stability. Under certain test conditions, it lost little or no viscosity at 100°C over 720 days, and only 10 to 20% of the original viscosity at 105°C for over 460 days. In contrast to scleroglucan the xanthans were less stable. Depending on the source of the xanthan and the test conditions, viscosity losses varied from 10 to over 90%. The triple helix structure of scleroglucan may be responsible for its superior thermal stability.

46547 Design and optimization of alkaline flooding formulations. French, T.R. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Burchfield, T.E. pp. 615-626 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Two optimized alkaline systems which exhibit typical interfacial tension (IFT) behavior are described. One system was optimized with a very low acid (acid number = 0.13 mg KOH/g) crude oil from Delaware-Childers (OK), field. The other system was optimized with an acidic (acid number = 1.59 mg KOH/g) crude oil from Wilmington (CA), oil field. a mixture of synthetic surfactant and low-pH alkali produced lower IFT and sustained low IFT longer than either reactant alone. This effect was observed with the acidic crude and the slightly acidic crude. It was concluded that surfactant-enhanced alkaline flooding with low-pH alkalis shows promise with both acidic and slightly acidic oils. Laboratory results showed that surfactant losses by adsorption are reduced under alkaline conditions. Losses by precipitation should also be reduced due to the lowering of divalent ion concentration by alkaline preflush. The final section of this paper is an example of how screening criteria, phase behavior tests, and corefloods can be used to design and optimize an alkaline flood for a specific oil field. The example is for the design of a low-pH, surfactant-enhanced alkaline flood in the Ranger Zone of the Wilmington (CA), field, where a high-pH alkaline flood was previously conducted. That project encountered severe problems with alkali consumption and scaling. A low-pH alkali (such as $NaHCO_3$ or $NaHCO_3 + Na_2CO_3$) in combination with synthetic surfactant should be effective for producing incremental oil in the Ranger Zone of Wilmington field. Problems associated with high pH floods, such as intractable scales and high consumption, will be mitigated.

46548 Percolation theory of foam in porous media. Chou, S.I. (Chevron Oil Field Research Co., La Habra, CA (USA)). pp. 627-642 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A statistical network model and percolation theory are presented to describe the behavior of foam in porous media. Central to the present theory are constrained pore throat and pore body size distribution functions which characterize the converging/diverging nature of the pore geometry and the assumption that foam lamellae are generated by snap-off in pores with an aspect ratio greater than some critical value. The probability of snap-off and the percolating conductivity of the network are calculated, approximated by a Bethe tree, which relates to two-phase permeabilities. Results show that foam generation critically depends on the pore size distributions and that a strong foam could be generated by the snap-off mechanism, provided that the average pore aspect ratio is sufficiently large. Consistent with experimental observations, the theory predicts that gas relative permeability is greatly decreased by foam and approaches zero at the trapped gas saturation corresponding to the minimum gas saturation below which the gas channels become discontinuous. Because snap-off occurs only in gas-occupied pores, the water relative permeability is not affected by foam. Thus, the theory is able to describe quantitatively gas and water relative permeabilities with or without foam. The predicted relative permeabilities together with Darcy's law of two-phase flow explain much of the anomalous behaviors of foam in porous media, including the near-constancy of steady state saturation in the presence of a strong foam and the seemingly contradictory effects of gas and liquid flow rates on foam. The possibility of foam generation by imbibition and the effects of rock permeability, wettability, and the presence of residual oil on foam displacements are also discussed.

46549 Experimental validation of a new method for optimizing miscible flooding of stratified reservoirs. Ingsoey, P.; Skjaeveland, S.M. pp. 643-652 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Miscible displacement experiments were conducted in a stratified model reservoirs that permitted visual observation of the flow processes. Concentrating on favorable mobility ratio displacements, the results are analyzed by a VE theory which includes gravity effects. The results show that the front shape, and hence the recovery, of gravity stable displacements can be predicted by the theory. Further, rates for breakdown of gravity stabilization are predicted in agreement with experimental results. It is shown that channeling of the injection fluid into high permeability layers may be stabilized by viscous cross-flow, even during relatively high injection rates. Observation of unexpectedly large mixing zones are explained as viscous mixing caused by cross flow between layers.

46550 Numerical simulation of single-well polymer gel treatments in heterogeneous formations. Hughes, D.S.; Woods, C.L.; Crofts, H.J.; Dixon, R.T. pp. 653-664 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

High watercuts are a pressing problem in North Sea fields. The application of polymer gels to block-off the water producing layers

has been judged successful in many American fields, and this established technology may be fairly readily extendable to the more demanding conditions offshore. A difficulty is that there is generally some vertical communication between the geological layers. A radial, near-wellbore model has been constructed for the Ness layers of the Upper Brent reservoir of a representative field. The pre- and post-production phases of gel treatments have been simulated, with the effects on fluid mobilities of polymer adsorption and gelation modeled directly. The effects of various degrees of vertical communication, and gel strategies and properties have been investigated. Principal conclusions are: (i) Near-wellbore gel treatments would be effective providing there is at least some restriction to vertical flow. (ii) Low concentration thin gels act mainly through the permeability-reducing property of the adsorbed gel, whereas higher concentration thick gels act mainly through the increased viscosity of the aqueous phase. (iii) It is more effective to inject gel into only the watered-out layers; and this strategy is favored more for thicker gels. (iv) Thick gel treatments without selective completion block all except the highest-permeability layer. They should therefore only be considered if this layer still contains mobile oil, the watercut is high, and production is currently limited by handling capacity.

46551 Factors governing formation damage and injectivity of polymer. Fletcher, A.J.P.; Lamb, S.P.; Clifford, P.J. pp. 665-676 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Here the authors combine the results of a laboratory core injection study, with computer simulation of how face-plugging affects fracture behavior. Physico-chemical environments which result in formation damage were assessed on a non-metallic, multi-pressure port, 2 meter coreflood rig. Unfiltered polymer solutions were responsible for injectivity problems at the core face. Total blocking did not result and an equilibrium was established allowing injection into the damaged core. Filtration to 5 μm removed the tendency to face block. Trace quantities of Fe(III) resulted in a steady decline of injectivity. At Fe(III) concentrations >3 ppm immediate and serious damage occurred. A firm gel resulted in face plugging and the consistency of the gel differed from that associated with unfiltered polymer. The face plugging was not associated with high retention levels of polymer within the core matrix. The damage caused by Fe(III) could be controlled by citric acid, which eliminated all tendency to face plug. A 3-D waterflood fracturing code, with calculation of rock and fluid mechanics, was modified to include a model of formation damage at the fracture face, based on the experimental data. It was used to calculate the effects of plugging on the fracture dimensions, bottom-hole pressure and injectivity of wells, over a range of conditions. Face-plugging which would severely reduce injectivity from a non-fractured well-bore is shown often to have the effect of increasing fracture size without loss of injectivity. With appropriate field system design and polymer solution properties, formation damage need not be a serious problem in polymer injection.

46552 Oil recovery from fractured reservoirs through imbibition by water and polymer flooding. Ghedan, S.G. (Univ. of Baghdad (Iraq)); Poettmann, F.H. pp. 677-688 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Polymer flooding of fractured reservoirs is a common occurrence. In the case of a water-wet fractured reservoir the primary recovery mechanism can be by imbibition. This paper presents the results of an experimental and theoretical study investigating the effect that polymers have on the imbibition process. Two sets of experiments were performed, static and dynamic. The results of the static experiments, in which a matrix block is surrounded by the imbibing fluid, showed that the amount of oil that ultimately could be recovered by the water and polymer solutions imbibition are practically equal. However, the rate of oil recovery by the polymer solutions is always less than that of the water. The dynamic experiments consisted of flooding oil-saturated fractured cores through the fractures by water and different polymer solutions. The oil recovery behavior in these experiments was found to be dependent not only on the rate of injected fluid imbibition from the fracture into the matrix blocks, but also on the operating injection rate and the displacement efficiency of the oil in the fracture by the injected fluid.

46553 Foams as mobility control agents for oil recovery by gas displacement. Llave, F.M. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Chung, F.T.H.; Louvier, R.W.; Hudgins, D.A. pp. 689-702 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract FC22-83FE60149. (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper presents the results of studies that involved: (1) foam flow behavior in smooth capillary tubes and packed glass tubes; (2) effects of changes in injection rates on foam performance; (3) effects of foams on unsteady state gas-liquid relative permeabilities; and (4) effects of foams on improving gas sweep efficiency. The apparent viscosities and mobilities of foams flowing through smooth capillaries and packed glass tubes were measured. The experiments were designed to observe the quantify the behavior of foam under various conditions including foam quality, shear rate, surfactant concentration, and temperature. The bubble size distribution of pregenerated foam was measured to determine the contribution of foam texture to its flow behavior. Experimental results were evaluated using available mathematical models developed for predicting apparent viscosities of foam in smooth capillary tubes and packed glass tubes. Core flooding experiments were conducted to evaluate effects of variations in injection rates on foam performance as a mobility control agent. Results of the experiments showed that higher injection rates of nitrogen displacing a surfactant solution resulted in foam generation that contributed to a significant increase in sustained pressure gradient across the core. The unsteady state method was used to study the effects of foam injection on gas-liquid relative permeabilities and improving sweep efficiency in Berea sandstone cores. The presence of foam resulted in a significant reduction of the permeability of the core to gas. The ability of a foam of known texture to sustain differential pressures across a core in the absence of flow was also determined. Using a parallel coreflood setup, fluid flow was preferentially diverted from a high-permeability core to a low-permeability core.

46554 A method of alternating steam and water injection for recovering heavy oils. Sufi, A.H. pp. 703-716 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Various techniques have been suggested for injecting steam into heavy oil reservoirs that offer limited injectivity into the formation. These include the use of any water-saturated stringers that may be present in the pay or the use of horizontal wells to heat the reservoir from the injector to the producer. An experimental study was conducted using a scaled physical model to study the scenario with a horizontal well. The model was an element of symmetry from a reservoir having no initial fluid mobility. A horizontal well was placed at the base of the model to heat the formation from a vertical injector to a vertical producer. Results of injecting steam into the region heated by the horizontal well were disappointing due to low mass injection rates. It was possible to inject high mass rates using hot water as the injected fluid. This however, resulted in relatively low oil production rates. To obtain a balance between high mass injection rates and high oil production rates, a process of alternating steam and hot-water injection was developed. This allowed the reservoir to be heated as hot water was injected into the reservoir and oil to be produced by gravity drainage during steam injection. A number of alternating steam and hot water cycles were required before continuous steam injection at the maximum rate was possible. The initial heating time with the horizontal

well was varied with minimal effect. Using the alternating process, an oil recovery of 76.4% was achieved.

46555 Physical model steamflood studies using horizontal wells. Ahner, P.F.; Sufi, A.H. pp. 717-728 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A series of scaled physical model steamflood tests were made for several injection rates and flow configurations on heavy oil systems. A rectangular model was built to study drainage areas created by parallel horizontal wells. The model, which was scaled for viscous and gravitational forces, had vertical wells at each corner (two injection and two production wells). These wells corresponded to injectors and producers drilled on a line drive pattern. Two horizontal wells, each placed between injector/producer pairs, were used to heat the surrounding formation by conduction, thereby providing initial mobility for the fluids. Alternating hot water and steam injection, as well as various horizontal well flow schemes, were also studied. These included injecting steam from a common source to both the injector/producer pairs, a case which resulted in uneven steam distribution into the model. Line drive steamflood operation was simulated over both 1.37 and 2.75 acre patterns at steam injection rates of 427 bbl/day and 650 bbl/day. These tests, which yielded recoveries of 60-80% of the OOIP, revealed that the process of initiating injection using horizontal well heating can be used successfully in draining heavy oil reservoirs.

46556 Results and difficulties of the world's largest in-situ combustion process: Suplacu de Barcau field, Romania. Carcoana, A. (North Dakota State Univ., Fargo (USA)). pp. 729-736 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The Suplacu de Barcau oil reservoir, a monocline with 5° average dip north and located in the northwestern part of Romania, is a shallow unconsolidated sand with high porosity and permeability and with 295 MM bbls (46.9 x $10^6 sm^3$) of 2,000 cp original oil in place. After a pilot test was initiated up the structure in 1964 the inverted five-spot combustion pattern was expanded and gradually replaced by a line of injection wells. The actual five miles long in-situ combustion front is moving down dip being sustained by injecting 120 MM scf/day (3.36 x $10^4 sm^3$/day) into 100 injection wells. The balance is maintained by the oil, water, combustion gases and nitrogen produced through 600 wells influenced by combustion. The burning front advancing down structure is followed by the line of injection wells, transferring the air injection to the producers exceeded by the front. The difficulties encountered are related with mud and steam volcanos appearing high structurally in isolated areas, and with the evacuation of large volumes of combustion gas sometimes containing CO. Also the presence of hazardous gas in the basement of some village houses which overlap the combustion zone is threatening the area. Remedial work is needed also to overcome other difficulties such as injectivity reduction, rebel emulsions, excessive heating of some of the producers, and failure to avoid the back pressure which inhibits flow from the formation into the producer's well bores.

46557 History matching of a heavy-oil combustion pilot in Romania. Petit, H.J.M. (Institut Francais du Petrole, Rueil Malmaison (France)); Le Thiez, P.; Lemonnier, P. pp. 737-750 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Many papers have been published in recent years on the numerical modeling of in-situ combustion. They have mainly dealt with numerical formulations, but very few have been devoted to field history-match, especially concerning heavy-oil. Among the fields exploited by in-situ combustion, Suplacu de Barcau in Romania, with its very high-viscosity oil (2,000 mPa.s at reservoir conditions), offers an interesting case for bringing out the main difficulties encountered during history-matching with a 3D in-situ combustion simulator. This paper describes the different phases of the numerical study made on the initial 5-spot pattern using a compositional thermal model. An effort was made to simulate the reaction aspects in radial geometry (ignition phase and propagation of the combustion front) and then to perform 3D match of production data. The different choices concerning the description of the reservoir, the definition of the kinematic parameters related to the laboratory tests performed and the numerical parameters are described. In spite of various uncertainties as to the pilot test data and the reservoir description, it was possible to: (1) obtain very good agreement for the propagation of the combustion front and the temperature distribution; and (2) reproduce the oil and gas production curves and the injection pressure.

46558 Improvement of gravity drainage by steam injection into a fissured reservoir: An analytical evaluation. van Wunnik, J.N.M. (Koninklijke/Shell Lab., Amsterdam (Netherlands)); Wit, K. pp. 763-772 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The improvement of gas/oil gravity drainage by steam injection in a densely fissured dome-shaped reservoir has been studied using analytical techniques. The following aspects of the process have been studied: the mixing of the steam and the hydrocarbon gas, the temperature distribution in the cap rock and the reservoir, the oil production by thermal expansion of the oil and by gravity drainage, and finally the shape of the hot/cold interface in the reservoir. The models developed are applied to the Qarn Alam reservoir of Oman, which could be a candidate reservoir. The steam injection process appears to be very attractive for this reservoir: an oil/steam ratio of 0.5 m^3/t may be achieved.

46559 The use of pulsed neutron capture logs to identify steam breakthrough - Case study: South Belridge Middle Expansion Steamflood Project. Masse, P.J.; Gosney, T.C.; Long, D.L. pp. 773-784 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Identification of steam breakthrough zones in a stacked sand/shale sequence with variable lateral continuity is difficult. This ability would enable the modification of field operations to enhance recovery through improved vertical sweep and heat injection. Twenty pulsed neutron capture (PNC) logs were run in an attempt to identify the steam breakthrough zone(s) in a seven pattern area of Mobil's Middle Expansion (MIDX) Steamflood Project in the South Belridge field. This information, along with data from recent replacement wells, was combined with a detailed geologic analysis. Evaluation of this combined information enabled the identification of potential steam breakthrough zone(s) and recommendations were made to modify operations to reduce and eliminate the steam breakthrough.

46560 Field studies of microbial EOR. Sheehy, A.J. (Univ. of Canberra, Australian Capital Territory (Australia)). pp. 785-790 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Microbiologically enhanced oil recovery (MEOR) is the use of microorganisms to facilitate, increase or extend oil production from a natural reservoir. The concept is more than 40 years old, however, early proposals were poorly conceived and in most instances of no practical value. Recent studies have developed microbial biotechnology to resolve specific production problems such as pressure depletion and sweep inefficiency in a target reservoir. Field trials to determine and document the effectiveness of microbial process, and to assess the validity of laboratory studies and models have

been conducted. The application of MEOR in these trials has resulted in a substantial and sustained increase in production compared to control operations on the same reservoir. Increased production has been sustained from a single treatment. A field assessment of the new technology in the Alton field is described. Twelve months after treatment an approximate 40% increase in net oil production continues. The test is unique because of the stringent controls applied during the assessment.

46561 **An application of geostatistics and fractal geometry for reservoir characterization.** Aasum, Y. (Univ. of Tulsa, OK (USA)); Kelkar, M.G.; Gupta, S.P. pp. 809-822 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This study presents an application of geostatistics and fractal geometry concepts for two-dimensional characterization of rock properties (k,ϕ) in a dolomitic, layered cake reservoir. The nature of the spatial correlation structure of rock properties affects oil displacement performance. Conventional reservoir characterization techniques may not take into account such spatial variability; but, two relatively new methods, indicator kriging and fractal geometry, may help in obtaining such information. Therefore, a scoping study was conducted to study the application of these two methods in evaluating a reservoir unit, while honoring geological information. Indicator kriging was applied areally, within a 5-spot pattern, for two different layers, separately. Fractal geometry was used to generate a vertical cross-section of reservoir properties (k,ϕ) between two of the wells in the 5-spot pattern. To assess the uncertainty of the various property distributions, single phase miscible displacements for M=5 were simulated using relatively fine grids over the characterized portions of the reservoir. A finite element model containing explicit longitudinal and transverse dispersivities was used for these simulations. Indicator kriging resulted in systems which behaved effectively random. Results were independent of the realizations. Systems generated by fractal interpolation behaved similar to linearly interpolated systems. The uncertainty in reservoir characterization using fractal geometry was reduced by incorporating geological information.

46562 **A new recovery technique for heavy oil reservoirs with bottomwater.** Chakma, A. (Univ. of Calgary, Alberta (Canada)); Islam, M.R. pp. 823-832 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A new recovery mechanism is proposed for heavy oil reservoirs containing a bottom-water zone. Many heavy oil reservoirs are considered to be unproductive due to the presence of a bottom-water zone. At present, there is no known mechanism of producing oil from these reservoirs. Recently, horizontal wells have been proposed as unique solution for producing reservoirs which are thin, fractured or contain a bottom-water zone. However, for heavy oil reservoirs, horizontal wells alone may not be sufficient. The electromagnetic heating process has been proven to be effective in in situ heating of oil bearing formations. Such heating, which is limited to small radii, in combination with a horizontal well offers an attractive process for recovering billions of barrels of oil unrecovered by other means. The process of electromagnetic heating is coupled with gas or water injection in order to create a favorable pressure gradient in the presence of a bottom-water zone. Scaled model experiments are performed to study the feasibility of the process of inert gas injection along with electromagnetic heating. The variables studied were oil-to-water zone thickness ratio, oil viscosity, horizontal well placement, inert gas injection rate and production well temperature. Recovery as high as 77% of the oil in place was obtained even in the presence of a bottom-water zone as thick as the oil zone. Under primary depletion these reservoirs are considered to be unproductive. This technique offers heavy oil production at a price lower than any other thermal recovery scheme.

46563 **Imbibition in low-permeability porous media: Understanding and improvement of oil recovery.** Cuiec, L.E. (Institute Francais du Petrole, Rueil Malmaison (France)); Bourbiaux, B.; Kalaydjian, F. pp. 833-846 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

This paper describes various experimental studies of spontaneous imbibition of oil by water in a low-permeability porous medium. Outcrop chalk samples were used. At constant and high interfacial tension, the importance of capillary forces and the existence of a predominant countercurrent mechanism were established. Additional experiments were also performed to investigate the influence of the length and of various boundary conditions. In another investigation, the interfacial tension at the boundary of the sample was modified by using pairs of conjugate phases of the n-hexane/ethanol/brine ternary system. It was observed that the kinetics of oil recovery is reduced but final recovery increases when IFT is lowered. A numerical interpretation is given for this last result.

46564 **Field measurements of remaining oil saturation.** Causin, E.; Rochon, J.; Marzorati, D. pp. 847-856 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Some of the most promising techniques proposed for evaluating the remaining oil saturation (ROS) of watered-out formations were tested in a few wells of three different fields Chuelles (France), Cortemaggiore (Italy) and a field in the Gulf of Guinea (Africa). The work was carried out with the following main objectives: to identify a screening for selecting the best ROS measurement method(s) to be applied under different reservoir and/or well conditions; to compare for the same well the results obtained applying different methods with various investigation depths; to emphasize the importance of the in-situ ROS determination in heterogeneous reservoirs. The techniques selected were: conventional carbon-oxygen logging; pulsed neutron capture tool (log-inject-log); single well tracer test; interwell tracer test. The logging methods give results in good agreement in the high-porosity reservoirs considered and can reveal a heterogeneous distribution of the oil saturation. The single well tracer test may be difficult to interpret when a significant heterogeneity and/or fluid drift occurs. In other cases, this tracer method can be very accurate. The interwell tracer test can give interesting results about flow behavior in the reservoir, despite difficulties of test analysis. It can also measure an average ROS value at the end of a flooding process. From this series of on-site experiments, the authors conclude that: using more than one method improves the accuracy of in-situ ROS determinations; ROS measurements performed on one well are representative of the surrounding area; in-situ ROS measured at the end of the flooding process may be quite different from the residual oil saturation (Sor) measured in laboratory.

46565 **Injection/production monitoring: An effective method for reservoir characterization.** Honapour, M.M. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Tomutsa, L. pp. 857-870 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract FC22-83FE60149. (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Geological heterogeneities controlling fluid flow paths in the Department of Energy Tertiary Incentive Project (TIP) area in Unit A of Bell Creek (MT) field were identified and described using injection, production, pressure, pressure falloff, and pulse test data. Monthly injection rate and pressure data, over a period of 10 years of linedrive waterflooding followed by 6 years of 20-acre, five-spot, water and micellar-polymer injection, were analyzed using the Hall

plot method. Water production front tracking and mathematical simulation results were integrated with information obtained from geological analysis and provided an improved interwell formation characterization. This integrative approach provided information about interwell reservoir properties such as directional transmissivities, fluid flow patterns, residual oil saturation, degree of continuity, presence of flow barriers, and permeability conduits. In the TIP area, analysis of the injection data with the Hall method provided distinct directional formation transmissivity for the preflush, micellar, and polymer stages of injection. Analyses of pressure-pulse and falloff tests conducted before the application of the chemical flood provided a baseline for comparing directional flow characteristics. The influence of various geological heterogeneities such as faults/permeability variations on fluid flow characteristics of the reservoir at various stages of linedrive waterflooding and chemical flooding was identified. The results show good agreement with any complement information obtained from geological, petrophysical, and petrographical analyses. They also indicate that the effects of micellar and polymer adsorption/retention on fluid flow characteristics of a reservoir can be quantified using the Hall plot method.

46566 Characterization of crude oil wetting behavior by adhesion tests. Buckley, J.S. (New Mexico Institute of Mining and Technology, Socorro (USA)); Morrow, N.R. pp. 871-878 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Wettability in a rock/oil/brine system determines the distribution of fluids and can have a dramatic effect on oil recovery. A better understanding of the state of wetting in the presence of a crude oil is required for design of displacement experiments and interpretation of results for satisfactory prediction of oil recovery by waterflooding. The adhesion test has been developed to characterize interactions between a crude oil and brines of varying composition. Adhesion maps show several consistent trends for most of the crude oils examined which are unlike those for refined mineral oils. At low salinity, there is a characteristic pH above which adhesion does not occur. This pH has been shown to correspond reasonably well with the cutoff predicted by calculations based on electrostatic forces and DLVO theory. In higher salinity brines, electrostatic forces are less important, and the adhesion test results indicate that other mechanisms must be responsible for determining wetting behavior. In this area of greatest practical interest, the adhesion test provides an empirical measure of the interactions between oil and solid. The effects of temperature, surface preparation, oil composition, and oxidation are reported.

46567 Capillary number relations for some North Sea reservoir sandstones. Garnes, J.M. (Norsk Hydro, Oslo (Norway)); Mathisen, A.M.; Scheie, A.; Skauge, A. pp. 879-890 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The paper summarizes measurements of capillary desaturation curves for some North Sea sandstone reservoirs, which are candidates for enhanced oil recovery processes. The capillary number, N_c, is altered both by increase of the viscous forces and by reduction of the capillary forces (lowering of interfacial tension). The capillary desaturation curves, CDC, are compared to the pore size distribution, XRD, liquid permeability, and dispersion coefficient, measured on the same core material. The critical capillary number and the shape of the CDC are interpreted by dispersion/capacitance effects, pore size distribution and wettability, and are found to correlate to both the dispersivity and the permeability of the cores. Cores drilled with oil based mud showed only minor change in oil saturation, when the capillary number were increased. While cores drilled with water based mud gave a normal decrease in oil saturation at high N_c. After applying a multi-step cleaning procedure, the CDC was in agreement with results from water based cores from the same formation. The capillary desaturation data is compared to result of sandstone from other areas, showing that some North Sea sandstones are good candidates for enhanced oil recovery processes based on lowering of the interfacial tensions.

46568 A model for small-scale permeability measurement with applications to reservoir characterization. Jensen, J.L. (Heriot-Watt Univ., Edinburgh (England)). pp. 891-900 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Traditionally, quantitative assessment of small-scale permeability variations has depended primarily upon core plug measurements. Minipermeameters, however, are increasingly being used to supplement core plug data despite some unresolved issues concerning the minipermeameter measurement. Two of the more important are whether the minipermeameter can provide a truly quantitative assessment of permeability and how the measurements may be applied in reservoir description. To address these issues, a statistical model of minipermeameter and core plug measurements has been developed. The model uses the Monte Carlo method to emulate both sampling techniques. Three applications of such measurements were examined using the model: correlations of permeability with wireline porosity log measurements; heterogeneity measurement; and prediction of effective permeability. In all three cases, the authors found that, even if the minipermeameter does not give a precise permeability value, the ability to sample frequently can provide more accurate information about formation properties than does core plug data taken at one foot intervals.

46569 Experimental and theoretical determination of residual saturations after a water-driven carbon dioxide flood. Deo, M.D. (Univ. of Utah, Salt Lake City (USA)); Deans, H.A. pp. 901-914 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

An approach similar to the determination of residual gas saturation by single well injection/production technique has been investigated to determine saturations of trapped phases after a water-driven CO_2-enhanced oil recovery process. Theoretically, the theory of multicomponent, multiphase flow in porous media was applied to the flow reversal situation to show that the interaction of phase behavior and flow reversal leads to nonreversing composition paths, which can be used to obtain meaningful information about the state of the reservoir before the test. Experimentally, a single residual phase of various compositions was first established in the core and the saturations determined by volumetric balance. The saturation so established was then measured by using the fluid injection/production test and was in good agreement with the saturations established by volumetric balances. Extensions of the method to determine two residual phases simultaneously in the pore space in the three- and four-component cases was explored theoretically.

46570 An evaluation of cubic equations of state for phase behavior calculations near miscibility conditions. Danesh, A. (Heriot-Watt Univ., Edinburgh (England)); Xu, Donghai; Todd, A.C. pp. 915-924 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

The paper presents results from vapor-liquid equilibrium experiments simulating gas injection processes, using 25-component fluids as black and volatile oils. Gases were added to the oil to approach the system to the critical point (miscibility) and the volume, density and compositions of equilibrated phases were measured at various levels of pressure and added gases. The measured near miscibility data as well as pertinent literature data have been used to evaluate the reliability of EOS modeling. It is shown that while certain EOS are capable of predicting the phase behavior at these conditions, others, including some widely used equations, can give

unreliable results. The predicted volumes of equilibrated phases are shown to be particularly inaccurate with deviations over 100%. A volume translation method, based on equilibrium ratios, has been proposed to improve the predicted phase density for mixtures near critical point. The significance of input compositional and volumetric data for accurate phase behavior prediction near miscibility is demonstrated.

46571 Design and results of a shallow, light oil field-wide application of CO_2 huff n puff process. Miller, B.J. pp. 925-932 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A CO_2 huff and puff process has shown to be economic at current oil prices in a shallow oil field in the Appalachian Basin. Design and field results are reviewed. The project shows excellent results for a tight, light oil reservoir at immiscible conditions. The results of 200 treatments (340 to 4,130 Mscf (9,630 to 116,900 m^3) each) over a four year period are investigated. The results of a second treatment on wells that had been treated over three years prior are also shown. Mechanical failures have been published as attributing to partial failure of other huff and puff projects; thus, prescreening and small treatments have been used to minimize this problem. The mechanics of the treatment will be reviewed with an emphasis on simplicity and safety. The production response from the treatments have been from one to four years. The response developed from field tests of different sizes will be reviewed and correlated with reservoir parameters. The complex relationships among these factors leads to the need for modeling that will not only predict the ultimate recovery efficiency but also the response curve for specific wells for project optimization. The optimum treatment or combination of treatments for a well is not where the CO_2 utilization efficiency for the total treatment is maximized but where the net revenue is maximized. With the high cash turnover rate, a project can be designed to minimize the working capital exposed and maximize the project cash flow. The primary project area covers over 400 wells in the same reservoir with varying reservoir and production parameters. Initial treatments have been set up to test all the wells. Information from these treatments are helping to supply data for modeling and multiple linear regression analysis.

46572 A flue gas huff n puff process for oil recovery from shallow formations. Johnson, H.R.; Schmidt, L.D.; Thrash, L.D. pp. 933-940 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). DOE Contract AC22-86BC14000. (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Troutman Oil Co., Inc. of LaCygne, Kansas has developed a low-cost process for recovery of oil from shallow oil formations. The process (named TWINCO2) relies on immiscible displacement of oil through the injection of flue gas in a cyclic injection program. It was first installed in the LaCygne-Cadmus field located in Linn County, Kansas. The project has been in continuous use since 1979. Oil production rates have stabilized and the project has proven to be cost-effective given its small investment requirements and low operating costs. Flue gas is generated by burning natural gas in an internal combustion engine. The exhaust gas is treated and is compressed to around 250 psi for injection into the reservoir. Following injection, the same well is converted to production and the well flows oil, water, and gas into surface separating units. The economics associated with this oil recovery process as reported in the paper have been updated to reflect 1989 prices and conditions. This analysis assumes that the oil producing wells and related oil production infrastructure are in place. The analyzed project area contained 51 wells in 225 acres. Incremental cost to install a system in 1989 similar in scale to that employed by Troutman Oil is estimated to be approximately $100,000. For the Troutman Oil scale of operations, the operating costs are estimated at $37,400 per year. Economic parameters are presented in this report which will enable the reader to estimate the economics associated with application of the process at a particular property, including the minimum oil production required to cover operating costs and repay the initial capital investment.

46573 Overview of gelled polymer projects conducted in central Kansas. Schoeling, L.G. (Univ. of Kansas, Lawrence (USA)); Green, D.W.; Jack, L.M. pp. 941 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Crosslinked polymer treatments are being implemented on both the injection and production-side in central Kansas to increase oil production and reduce water-oil ratios. In the past few years, Murfin Drilling Company has utilized these gel treatments and have had both successes and failures. This paper presents the results of two injection-side projects in the Lansing-Kansas City formation and four producing-side treatments in the Arbuckle formation from an independent oil operator's point of view. The Lansing-Kansas City formation is a sequence of limestone reservoirs separated by shales. When these reservoirs are simultaneously waterflooded, usually the highest permeability zone takes the majority of the brine, causing poor sweep efficiency in the waterflood. Injection of gelled polymers can plug these high permeability zones thus increasing the waterflood sweep efficiency. Results from two projects in Decatur and Graham Counties are discussed. The Arbuckle formation is typically a dolomitic limestone reservoir underlain by bottom water. Water coning usually occurs due to gradients in flow potential established around the wellbore by oil production. If vertical permeability exists, this difference in flow potential causes mobile water to flow into the wellbore. Gelled polymer treatments can reduce the permeability to this mobile water, thus reducing the producing water-oil ratio. Typically, a sharp decrease in WOR is noted immediately following a treatment. This decrease is followed by an increasing WOR as the oil production gradually resumes its normal decline. Four treatments conducted in Ellis, Graham, and Rooks Counties are discussed.

46574 Waterflooding the Minnelusa with aluminum citrate gelled polymer, Powder River basin, Wyoming. King, W.A. pp. 942 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Because of their high permeability variation and high viscosity ratio, Minnelusa formation waterfloods have been polymer/flooded for many years. To increase polymer viscosity in situ, alternate injections of aluminum citrate and polymer were begun in the mid 1970's. The results were difficult to document and the probability of efficient in situ mixing and, therefore, efficient in situ gellation was questioned. The problem of efficient mixing was solved in the mid-1980's when aluminum citrate was mixed with polymer on the surface just prior to injection. Gellation would occur underground. The continuous surface mixing of polymer with aluminum citrate has become standard practice in the Powder River Basins Minnelusa waterfloods. Although continuous mixing has become standard practice, the technology is still evolving. Many questions have been raised and a few have been answered. What is the optimum polymer/Al^{+++} ratio? Is the gel getting out into the reservoir? Is polymer shear at the perforations a problem and can it be measured? What happens when Polymer-Al^{+++} is injected in produced water? Should gel strength be measured at the field or in the laboratory? Is there a difference? How does sulfate reducing bacteria affect the polymer and how is it measured and treated? Is the continuous mixing of polymer and aluminum a profitable procedure? This presentation focuses on three Minnelusa Fields where the continuous mixing of polymer and aluminum citrate has been used. The procedures employed, and the lessons learned are discussed. Particular emphasis is placed on the importance of continuously taking the pulse of the project by field testing with close laboratory support.

46575 Operating EOR [Enhanced Oil Recovery] projects: The experience of an independent energy company. Covey, F.D.; Craig, F.F. III. pp. 943 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

A major producer of natural gas and natural gas liquids, Mitchell Energy Corporation also produces 5,200 barrels per day of crude oil and condensate, 15% due to secondary (waterflood) operations and 16% due to tertiary (enhanced) operations. This presentation examines Mitchell's Enhanced Oil Recovery (EOR) philosophy and commitment and the role EOR plays in Corporate operations. Manpower size and capabilities are discussed, along with Corporate efforts to keep personnel technically up-to-date in the rapidly changing EOR environment. The independent's advantages and limitations with regard to EOR operations are highlighted by describing the development chronology of Mitchell's Alvord South (Caddo) Unit, a full-field carbon miscible flood located near Fort Worth, Texas. The impact of Corporate innovations, such as development of a patented carbon dioxide tracer system and the application of hand-held computers to data gathering and reporting, as well as the impact of industry-wide events, such as the end of the DOE's Tertiary Front-end Recoupment Program and the 1986 collapse of oil prices, are continuing to play a major role in the technical and economic outcome of the Alvord South (Caddo) project. Mitchell's view of the EOR potential for independents under current conditions is also reviewed.

46576 Sewer water: An alternate water source for a CO_2 EOR [enhanced oil recovery] project. Flanders, W.A.; Grahmann, N.; Green, G. pp. 944 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426–: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Water is utilized in oil field operations to increase oil recovery by conventional water flood and is increasingly being used in enhanced oil recover (EOR) technology. In many areas there is not a sufficient supply of water from subsurface salt water formations. Shallow fresh water sands have been used in the past as an alternative source when the fresh water was compatible with the reservoir water and formation. Use of the fresh water is not practical in many areas. An extreme strain has been placed on the limited fresh water supply by its use for the general population and agricultural irrigation. Effluent from municipal sewer plants can be used an alternate source of water for the oil field. Sewer water is being utilized successfully as the water source for the water injection requirements in the Hansford Marmaton CO_2 EOR project. The source of water for the project is a portion of the 10,000 barrels of water per day available from the effluent of the water treatment plant in the small city of Spearman, Texas, population 3,800. Prior to injection, the water must be deoxidized, bacteria must be killed, and the suspended oil and grease must be removed. This paper reviews how these processes are being accomplished for the Hansford Marmaton Project. Additionally the problems encountered in installing the system, how they were resolved, the cost to implement and operate the water injection system are reviewed.

0204 Processing

Refer also to citation(s) 46359, 46376

46577 (IFP–37-154) **Normal heptane transformation on a hydrocracking zeolitic catalyst in presence of hydrogen sulfide and ammonia.** Quesada Perez, A.M. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). 1989. 142p. (In French). Order Number DE90518454. Source: NTIS (US Sales Only), PC A07/MF A01.

Transformation of normal heptane on Ni Mo/Zeolite USY catalysts in presence of hydrogen sulfide and ammonia is studied. After a bibliographic study of hydrocracking, catalysts, operating methods and reagents are described. Influence of time of contact and of temperature on heptane transformation in presence of ammonia are investigated. Influence of ammonia partial pressure on activity and selectivity of hydrocracking catalysts, hydrogen sulfide partial pressure on Ni Mo/USY catalyst performance and kinetics are examined.

46578 (IFP–37-256) **Zeolite deactivation mode. Coked zeolite characterization by adsorption of various molecules.** Mignard, S. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Poitiers Univ., 86 (France). 1988. 172p. (In French). Order Number DE90518447. Source: NTIS (US Sales Only), PC A08/MF A01.

Deactivation of 5 usual zeolites (Fanjasite, Mordenite, offretite, ZSM5 and erionite) are studied in n-heptane cracking. Polyaromatic compounds, called coke, are deposited inside zeolite channels. Characterization of zeolite porosity and acidity allows to specify deactivation. Porous volume is determined in function of coke ratio for molecules of different size: nitrogen, n-hexane, 3-methyl pentane, xylene. Coke deposit in zeolite structure is located by porous volume variations. Zeolite acidity is determined by ammonia adsorption and microcalorimetry showing that acid sites accessible to this small molecule can catalyse the reaction. Deactivation of zeolite catalysts with large or medium pores comes essentially from inaccessibility of molecules to active sites inside the porous network and not to coke poisoning.

46579 (IFP–37-664) **Study of catalytic properties of modified zeolites with large size pores.** Jacquinot, E. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). Jun 1989. 209p. (In French). Order Number DE90518453. Source: NTIS (US Sales Only), PC A10/MF A01.

Stabilized and dealuminated zeolites are prepared from Y, omega, L and beta zeolites with pores constituted by rings with 12 oxygen atoms. These catalysts are tested first for conversion of cyclohexene, then on a vacuum distillate to study the selectivity of hydrogen transfer in bimolecular reactions, which is responsible for octane number decrease and coking. Influence of acid sites and porous network on catalytic properties are examined.

46580 Hydrous oxide ion-exchange compound catalysts. Dosch, R.G.; Stephens, H.P. To Dept. of Energy, Washington, DC (USA). USA Patent 4,929,582/A/. 29 May 1990. Filed date 9 Apr 1986. USA Patent Application 6-849,913. Int. Cl. B01J 21/06. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a catalytic material of improved activity. It comprises a hydrous, alkali metal or alkaline earth metal or quaternary ammonium titanate, zirconate, niobate, or tantalate, in which the metal or ammonium cations have been exchange with a catalytically effective quantity of a catalyst metal, and which has been subsequently treated with a solution of a Bronsted acid.

0205 Products and By-Products

46581 (DOE/PC/88827–T5) **Thermal stability of jet fuel: Final report, September 1988–December 1989.** Eser, S.; Song, C.; Copenhaver, R.M.; Perison, J.; Schobert, H.H. Pennsylvania State Univ., University Park, PA (USA). [1990]. 125p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88827. Order Number DE90016801. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The principal objectives of this study were to investigate the thermal stability of a suite of alkylated phenols as typical trace contaminants in jet fuels and to determine the thermal stability of various fractions of a coal-derived and a petroleum-derived JP-8 jet fuel as well as the thermal stability of the unfractionated fuels. The thermal treatment experiments were carried out in nitrogen and air atmospheres (100 psig cold) using 15 ml microautoclave reactors. The reactors were heated in a fluidized sand bath at temperatures ranging from 150°C to 450°C. The samples of the coal-derived and petroleum-derived jet fuels were separated into five distillate fractions and these fractions were characterized by high-resolution gas chromatography-mass spectrometry (GC-MS). The thermal

treatment products from the alkylated phenols were analyzed by ^{1}H and ^{13}C Nuclear Magnetic Resonance (NMR) spectroscopy and GC-MS. 20 figs., 13 tabs.

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 46575, 46613

46582 (DOE/EIA–0109(90/06)) **Petroleum supply monthly, June 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 30 Aug 1990. 127p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90017411. Source: NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

Data presented in the Petroleum Supply Monthly (PSM) describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply." Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States.

46583 (DOE/EIA–0520(90/08)) **International petroleum statistics report.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 28 Aug 1990. 45p. Sponsored by U.S. DOE Management & Administration. Order Number DE90016285. Source: NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

The International Petroleum Statistics Report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e. noncommunist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years.

46584 (DOE/EIA–M028(90)) **Oil market simulation model: User's manual.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Jun 1990. 17p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90015982. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Oil Market Simulation (OMS) model is a LOTUS 1-2-3 spreadsheet that simulates the world oil market. OMS is an annual model that projects the world oil market through the year 2010 from a data base that begins in 1979. The geographic coverage includes all market economies, with net imports from the centrally planned economies taken as an assumption. The model estimates the effects of price changes on oil supply and demand and computes an oil price path over time that allows supply and demand to remain in balance within the market economies area as a whole. 2 figs., 2 tabs.

0208 Waste Management

Refer also to citation(s) 46391

0209 Environmental Aspects

Refer also to citation(s) 47562

46585 (AD-A–222235/4/XAB) **Demonstration of thermal stripping of JP-4 and other VOCS from soils at Tinker Air Force Base Oklahoma City, Oklahoma. Final report, September 1988-March 1990.** Marks, P.J.; Noland, J.W.; Nielson, R.K. Weston (Roy F.), Inc., West Chester, PA (USA). Mar 1990. 402p. Contract DAAAIS-88-D-0010. Source: NTIS, PC A18/MF A03.

The patented Low Temperature Thermal Treatment (LT3) System was previously proven to be successful in treating soils contaminated with volatile organic compounds and petroleum hydrocarbons. This demonstration broadened the applicability to include soils contaminated with aviation fuel and other halogenated solvents. Several test were conducted to verify the effectiveness of the LT3 system. While meeting all goal cleanup objectives, a processing rate of 20,000 lb/hr was demonstrated with a projected LT3 System processing cost of $86/ton. A number of system changes and process improvements are recommended. The system proved to be an efficient, cost-effective, and commercially available remediation alternative for decontaminating soils.

46586 (AD-A–222348/5/XAB) **Enhanced bioreclamation of jet fuels: A full-scale test at Eglin AFB, Florida. Final report, November 1986-November 1988.** Hinchee, R.E.; Downey, D.C.; Slaughter, J.K.; Selby, D.A.; Westray, M.S. EA Engineering, Science, and Technology, Inc., Lafayette, CA (USA). Sep 1989. 179p. Contract F08635-86-C-0341. Source: NTIS, PC A09/MF A01.

This report presents the results of a two-year, full-scale field test of enhanced biodegradation conducted at a JP-4 jet fuel spill site on Eglin AFB FL. A complete description of site characterization methods, the enhanced biodegradation process and hardware, and the impact of this technology on soil and ground water contaminants is provided. The report emphasizes the treatment limitations of this technology that were observed through intense monitoring of soil and ground water contaminant profiles. Significant problems with hydrogen peroxide decomposition were documented in this test. This rapid decomposition resulted in poor oxygen distribution and biodegradation rates which were far less than laboratory microcosm studies had predicted. Several recommendations for improving field applications of enhanced biodegradation are provided, including a checklist for performing pilot tests of this technology.

46587 (AD-A–222446/7/XAB) **Simulation of oil-slick transport in Great Lakes connecting channels. Theory and model formulation.** Shen, H.T.; Yapa, P.D.; Petroski, M.E. Clarkson Coll. of Tech., Potsdam, NY (USA). Feb 1990. 36p. Contract DACA33-85-C-0001. Source: NTIS, PC A03/MF A01.

Two-dimensional computer models for simulating oil slick movement in rivers and lakes were developed and then applied to the connecting channels of the upper Great Lakes. In these models the oil slick is considered to be a collection of discrete oil patches. The transformation of an oil slick due to advection, spreading, evaporation and dissolution are considered. In open-water regions the advection of oil patches in the slick are determined by the water current and wind using the drifting factor formulation. Formulas consider the balance of inertia, gravity, viscous and surface tension forces. The oil slick transformation model developed in this study contains as many processes as can be effectively and analytically modeled. The model has several special features, including the ability to model instantaneous and continuous spills, the ability to realistically describe the irregular shapes of an oil slick and the ability to account for the time-dependent variation of the flow conditions. The computer programs are designed so that it will be easy to refine the model elements and expand the model to include additional slick transformation processes.

46588 (BSE-PROC–22) **Oil pollution questions.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. 270p. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

The Oil Pollution Seminar was, as endorsed by the Seventh Meeting of the Helsinki Commission, organized by the Governments of Sweden and Finland. The seminar was held in Norrkoeping, Sweden, 19-20 November 1986. The aim of the seminar was to coordinate and exchange information on ongoing work on oil pollution questions within the Convention Area. The group was to summarize the results of the seminar and make proposals to the subsidiary bodies of the Helsinki Commission on areas

where future work might be fruitful. Representatives of all the seven Contracting Parties to the Helsinki Convention attended the seminar, i.e. Denmark, Finland, the German Democratic Republic, the Federal Republic of Germany, Poland, Sweden and the Union of Soviet Socialist Republics. Moreover, a representative from Norway was also invited to the seminar.

46589 (BSE-PROC–22, pp. 93-102) **Swedish monitoring of petroleum hydrocarbons in the waters of the Baltic and the Kattegat since 1970.** Carlberg, S. (Swedish Meteorological and Hydrological Institute, Gothenburg (Sweden). Oceanographical Laboratory). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Regular monitoring of petroleum hydrocarbons in the sea areas surrounding Sweden has been carried out since early 1970, with only a short discontinuity from March 1976 to August 1978. In the first period the infra-red spectrophotometric method was used and in the second period this was exchanged for the more sensitive ultraviolet spectrophotofluorimetric method. Results of the latter show that the concentrations obtained are usually low or very low, ranging from below 1 μg/l to a few μg/l. The methods have been successfully intercalibrated at several occasions during the period. The monitoring is since 1983 part of the national Swedish monitoring programme (PMK) as a response to the agreement within the Helsinki Commission for the requirements of the Baltic Monitoring Programme (BMP). Results preliminary indicate that the concentrations of petroleum hydrocarbons are decreasing in the investigated area. However, this is yeat to be verified by statistical analysis of the data collected.

46590 (BSE-PROC–22, pp. 2-10) **Oil pollution load on the Baltic Sea; a compilation of measured and estimated load.** Enckell, E. (National Board of Waters and Environment, Helsinki (Finland)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Crude oil and oil products are handled and processed at many stages on its way from the production field to the users. At each stage chronic discharges or accidental spills take place. The crude oil as well as the products are of varying composition. Crude oil contains up to seven per cent by weight of sulphur and up to one per cent by weight of nitrogen. A small proportion of compounds contains oxygen. Thus most crude oils contain 10-40 per cent by weight of organic non-hydrocarbons. Moreover, many of the products change in the use and only some of the organic components in the spills and discharges are stable and do not oxidize. There, together with inexact analytical methods, are some of the reasons why there are considerable uncertainties in the estimates of the oil pollution load entering the marine environment. In the most recent attempt to estimate and compile the input of hydrocarbons to the Baltic Sea. The estimated total input of hydrocarbons (2.1-6.6 x 10^4 t/year) is essentially smaller than the two earlier estimates by Melvasalo et al in the first assessment on the Baltic Sea Area (5.0-10 x 10^4 t/year, 1981) and by Jensen and Joergensen in a Danish study (7.64 x 10^4 t/year, 1984). It might therefore be of interest to note that the estimates made by US National Academy of Sciences on a world-wide scale also have declined. Moreover, since the noxiousness of the load from the different sources is fairly unknown and by no means proportional to the amounts estimated, it would be wrong to base far going conclusions concerning the seriousness of the oil pollution from the varied sources. The need for conclusions still calls for better analytical methods and a better knowledge of the impacts.

46591 (BSE-PROC–22, pp. 39-50) **Increased levels of petroleum hydrocarbons in the surface sediments of Swedish coastal waters.** Mattsson, M. (IVL Baltic Sea Laboratory, Karlskrona (Sweden)); Lehtinen, C. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Petroleum hydrocarbons (PHCs) discharged into the sea in sewage waste water and run-off water or as atmospheric deposits are mainly adsorbed to particles. Thus, the fate of the petroleum hydrocarbons will depend mainly on distribution and sedimentation rates of these oil-contaminated particles. If the PHCs are released from a point source, the main accumulation in sediments often occurs within a short distance of the outlet. In 1974 and 1975 a survey of the bottom sediments around the Swedish coast was undertaken by Rudling. He sampled 68 stations located in the Bothnian Bay, the Baltic, Oeresund, Kattegat and Skagerrak. The main objective of the study was to evaluate and improve the analytical methods available for detection of petroleum hydrocarbons. Several analytical methods were tested and the extracted petroleum hydrocarbons were separated into a paraffinnaphthene and an aromatic fraction (3 or 3 ring). In the autumn of 1982, 61 of the 68 stations were revisited and the surface sediment sampled and analysed. The main objective of the study was to find out if the hydrocarbon levels of the surface sediment had changed significantly during the period between the two sampling occasions.

46592 (BSE-PROC–22, pp. 68-80) **Bacterial degradation of heavy fuel oil in seawater.** Gunkel, W. (Biologische Anstalt Helgoland, Helgoland (Germany, F. R.)); Dahlmann, G. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

By means of the glass capillary - gas chromatography method, the degradation of heavy fuel oil/Bunker C in seawater, as well as in seawater supplemented with N and P salts, could be determined. The investigations were carried out with incubation at 4 deg C and 18 deg C for varying length of time. Simultaneously the number of oil degrading bacteria and ordinary saprophytes were also determined. The greatest degradation occurs at 18 deg C with added supplements. At this treatment the numbers of oil degrading bacteria increase 10 million-fold within one week. The glass capillary - gas chromatography method also allows for quantitatively determining the decrease of individual components during the incubation. As an example, the degradation of naphthalene, of naphthalene, 1-methyl and of naphthalene, 2-methyl are presented.

46593 (BSE-PROC–22, pp. 81-91) **Effects of oil refinery effluents on receiving waters and sediments.** Talsi, T. (National Board of Waters and Environment, Helsinki (Finland). Helsinki District Office). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

The effects of effluents from Neste Oy's Porvoo Works in Finland have been studied since 1965. Most of the studies have been made under the supervision of the National Board of Waters and Environment in order to monitor the impact of the oil refinery on coastal waters. Moreover, more specific studies concerning, for example, the toxicity of the effluents have also been made. This paper presents an overview of the observations made during the last 20 years. The oily effluents and their impact will be focused on, although most of the studies made in the area have been concerned with the eutrophicating effects of the oil refinery. The concentration of oil in receiving waters has usually been low after the new purification plant was started. In sediments, however, the concentration of oil has not changed to any noticeable extent. Oily effluents have clearly affected the bottom fauna distribution in the area; therefore, even the smallest discharges of oil should not be ignored. In view of the size of Neste Oy's oil refinery, its impact on receiving waters and sediments is not extensive. The effluents may be slightly toxic to algae in the immediate discharge area, but the area thus affected is not large.

46594 (BSE-PROC–22, pp. 26-38) **Petroleum hydrocarbon emission from Swedish rivers.** Lennart, K. (Baltic Sea Laboratory, Karlskrona (Sweden). Swedish Environmental Research

Institute); Lehtinen, C. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Several estimates of the input of petroleum hydrocarbons (PHC) to the Baltic Sea point out river discharge as the dominating source. However, few measurements of PHC-concentrations in Swedish rivers have been carried out. Thus, the main objective of this study was to present some experimental data giving a base for better estimates of PHC-loads from rivers. Petroleum hydrocarbon concentrations were measured in water samples from the mouth of tem Swedish rivers. Based on these results, the extrapolated annual output from all Swedish rivers to the Baltic Sea was calculated to 2.200 t y^{-1} (aliphatics measured by gas chromatography) and 2.900 t y^{-1} (Total oil measured by fluorimetry).

46595 (BSE-PROC–22, pp. 115-131) **Petroleum hydrocarbons in water and sediments after an oil spill in the Gulf of Bothnia.** Vainio, T. (National Board of Waters and Environments, Vaasa (Finland). Vaasa District Office); Nyman, C.; Lax, H.; Sevola, P. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

The m/s Eira ran aground on August 31, 1984 in the Northern Quark in the Gulf of Bothnia. Some 200 tons of heavy fuel oil was spilled into the sea and approximately 2000 km^2 of the Finnish archipelago was polluted. Immediately after the oil spill the concentrations of hydrocarbons in water and bottom sediments were measured and the study was continued up to the end of 1985. The concentrations of hydrocarbons was measured using spectrofluorometry and gas chromatography. The highest concentrations in the sea water was registered about two weeks after the spill (10-20 μg/l). Concentrations significantly higher than the background level (0.2-2.0 μg/l) was not observed later than one month after the spill. The total hydrocarbon content in sediments varied between 1 and 130 μg/g. The analyses indicated slight oil contamination only in a few samples.

46596 (BSE-PROC–22, pp. 176-190) **Oil pollution control and monitoring in the Danish offshore industry.** Robson, M. (National Agency of Environmental Protection, Copenhagen (Denmark)); Joergensen, K.F.; Jensen, K. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

The article presents the oil pollution control and monitoring activities of the Danish National Agency of Environmental Protection (NAEP). The discharges of an substances or materials from offshore platforms and rigs can only take place with the pemission of NAEP, in this article the oil discharges are discussed. An interesting development in the Danish offshore industry is that oil discharged in produced water is becoming a larger and larger component of the total oil discharge.

46597 (BSE-PROC–22, pp. 191-201) **Biological degradability - a further criterion in testing chemicals against oil pollution.** Wunderlich, M. (Federal Institute of Hvydrology, Koblenz (Germany, F.R.)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

For testing individual chemical agents and complex mixtures of substances a large number of biological test methods are available today. These procedures embrace a wide range from simple laboratory tests to large-scale ecological investigations. Two dispersants and two reference substances (nonionic surfactants) have been tested for degradability. Both dispersants displayed ready degradability under experimental conditions. Only the method of TOC (Decrease of total organic carbon) determination shows certain disadvantages, because it also includes the biomass formed. FOr attaining an indubitable interpretation both the TOC and DOC (Decrease of dissolved organic carbon) ought to be determined. Our own results and those achieved by other institutes have led to the conclusion that degradability can be used as a criterion in testing dispersants. It is recommended to to apply, as analytics, the determination of DOC/TOC and of biochemical oxygen demand for further interpretation.

46598 (BSE-PROC–22, pp. 161-162) **On the procedures for separation of petroleum hydrocarbons in contaminated seawater samples into suspended, dissolved and dispersed forms: Alkane-naphthenic and aromatic fractions.** Oradovsky, S.G. (State Oceanographic Institute, Moscow (USSR)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Methodological recommendations for the separation of petroleum hydrocarbons in seawater to suspended and dissolved/dispersed forms, alkane-naphthenic and aromatic fractions have been worked out by the State Oceanographic Institute (Moscow, USSR). The methodology of separation to migration forms is based on stage precipitation of suspended matter from samples of seawater on filters with pore diameters 1.5; 1.0; 0.4 μ. Suspended petroleum hydrocarbons are extracted using cold percolation, and from filtrate - by extraction. The obtained percolate and extract can be prepared for separation of petroleum hydrocarbons in chemical fractions, or analysed without separation to fractions using common integral methods (for example IR-spectrophotometry). The method of separation to chemical fractions is based on eluation of these fractions from percolate or extract in glass pipette packed with aluminium oxide - silica (10:2) composed sorbent with eluates - penthan and ether. This method makes it possible to separate samples of oil spills to fractions and helps to identificate sources of oil pollution. The analysis of separated fractions can be performed using such common methods as gas chromatography for alkanes and naphthenics, spectrofluorometry and liquid chromatography for aromatics.

46599 (BSE-PROC–22, pp. 132-135) **Ongoing Swedish study on methods for the determination of oil in effluents.** Nystroem, E. (National Environmental Protection Board, Solna (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

The Environmental Protection Board in Sweden has initiated a project, the goal of which is to present recommendations on how oily effluents should be analysed. These recommendations are planned to be presented during spring 1987. A group with participants from industry and the Swedish Institute for Environmental Research has developed laboratory quidelines for three analytical methods that can be used for different purposes. These three are based on gas chromatography for lower aromatics, liquid chromatography for polyaromatic compounds are IR to get an estimate of the total organic content. Lower aromatics are of interest because of their toxicity and high solubility in water. Polyaromatic compounds are of interest because of their persistency and potential for bioaccumulation. During this autumn the different analytical methods will be tested on effluents from 15 different sources by a number of commercial and non-commercial laboratories. After any modifications that might be necessary the intention is to publish recommendations on how oil should be analysed. A possible solution is that IR-absorption is used in the routine monitoring while GC and LC will be used less frequently.

46600 (BSE-PROC–22, pp. 238-254) **Potential of laser remote sensing of oil below water surface.** Steinvall, O. (National Defense Research Institute, Linkoeping (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Many sensors have been developed to indicate the presence of an oil spill. Successful operations have been demonstrated by multispectral cameras, radars, infra-red line scanners and microwave radiometers. However, the potential of identifying and quantifying the anomaly by the above sensors is limited. The depth penetration is also non-existing with the exception of the multispectral camera working in the visible part of the spectrum. In recent years lasers have found an increasing interest for hydrographic applications which will make it a valuable complement to other sensors for oil spill detection and identification. In this paper the principles and functions of a laser fluorosensor and a laser bathymeter are presented and finally a combination of the laser bathymeter with the fluorosensor is discussed.

46601 (BSE-PROC–22, pp. 255-261) **Present day operational forecasting system and methods for the discovery of oil in the water column or at the sea bed.** Ambjoern, C. (Swedish Meteorological and Hydrological Institute, Norrkoeping (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions*. Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

A fully operational forecasting system is developed at our institute, SMHI, as a part of the combating organization. This system is to a great extent executed automatically by the computer. However, some specific information concerning the locality of the oil accident, the time of the spill and the thickness of the oil, is manually added to the calculation. The output shows the actual spreading at the water surface and different positions of the oil spill up to four days ahead counted from the starting point. Plotted maps are transmitted to the responsible authorities. This system can also be expanded into three-dimensional calculations of the oil in the total water column. These would give information about the levels at which the oil is propagating and spreading, the vertical transports as an effect of the density of the oil and the vertical turbulence. Finally, it would also tell where areas of the sea bed will be contaminated by sunk oil.

46602 (BSE-PROC–22, pp. 218-230) **Rules and guidelines for the approval procedure for and the use of oil spill dispersants.** Schalin, L.O. (National Environment Protection Board, Solna (Sweden). Water Protection Division). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions*. Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

On January 1, 1986 a new Act on Chemical Products entered into force in Sweden. At the same time a new authority, the National Chemicals Inspectorate, was installed. In connection to the Act a number of new ordinances were issued, among them the Ordinance on Certain Products Hazardous to Health and to the Environment. According to Section 10 in this Ordinance a chemical product is to be used for combating of oil, which has escaped in or adjacent to a water area or for clean-up following such a spill, only in accordance with regulations issued by the National Environmental Protection Board. In accordance with the Ordinance the chemical products intended for combating and clean-up after oil spills are to be approved by the National Environmental Protection Board. To get an approval the Board needs a description of the actual agent and its consequences in the environment. Tests concerning toxicity in water, efficiency by use, degradability, tendency of enrichment in organisms or in bottom sediments, ability to be stable when stored, etc. are ought to be shown. Statements of the efficiency of the dispersants and their ecotoxic characteristics are of special importance in the investigations. In general, Sweden cannot only rely on tests on dispersants made by other countries. In many cases complementary tests must be done under Baltic conditions before an agent can be approved for use in Sweden.

46603 (BSE-PROC–22, pp. 202-217) **Environmental aspects on the use of oil spill dispersants.** Lehtinen, C. (Neste Oy, Kulloo (Finland). Environmental Research Division). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions*. Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

In recent years, oil spill dispersants have been the subject of a number of studies and discussions. This was also the case in Sweden. During the first 10-15 years after the Torrey Canyon accident, oil spill dispersants were hardly used at all in Swedish waters. Due to new evidence regarding their environmental impact, however, the National Swedish Environment Protection Board decided to establish new guidelines for the acceptability and use of oil spill dispersants. The purpose of this work was to give a basis for the new guidelines. Thus, the research has focused on two main objectives: Information needed to define criteria for the acceptance of chemicals, i.e. registration procedures. Information needed to define guidelines on the use of dispersants. A full description of the work has been published by the National Swedish Environment Protection Board.

46604 (BSE-PROC–22, pp. 231-237) **The Sotka incident September 12, 1985.** Tuner, K. (Swedish Coast Gard Head Quarters, Stockholm (Sweden)). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions*. Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

At September 12, 1985 at 0012 AM (LT) the Finnish tanker Sotka(15.954 ton DW), bound for Naadendal (heading north) rammed and demolished a just newbuilt lighthouse at the ground Maerketsskallen in the Swedish part of Aalands hav between Sweden and Finland. Sotka was loaded with heavy fuel oil 1500 (HFO). After the collision Sotka continued its journey north and stopped after 1 hr, because the ship got a port list. After examination, it was found that a port wing ballast tank was ruptured and there was a leak of oil from the port cargo tank, but only small amounts of oil was seen from the ship. The Swedish Coast Guard also searched the area where Sotka had sailed, but could only find small amounts of oil (blue sheens, small lumps). September 17, some fishermen, in the area NW-W of the collision point, got oil on their fishing-gears and also got oil-contaminated fish (codfish). The Swedish Coast Guard searched the area both by patrol vessels and air surveillance, with no detections of oil. Also the bottom of the sea was surveilled by both Swedish and Finnish authorities as it was suspected that the oil had sunk. Only small droplets of oil just above the sea bottom was found on a few places. The lessons learned from this accident were that more attention shall be paid to the varying density of this type of oil. Leaking ships shall not be allowed to sail away from the collision/grounding point. Rapid measures must be taken even to lighter damaged tanks, and the fact that the oil, when cooled, might be on bottom of the tank must be considered.

46605 (IKU-R–22.1874.00/01/89) **Nordtest-identification of oil spills: Significance of photooxidation for the GC/MS-identification of oil spills.** Johnsen, S.; Brandvik, P.J. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Sep 1989. 35p. (In Norwegian). Order Number DE90518764. Source: NTIS (US Sales Only), PC A03/MF A01.

The report presents the test results from the identification of the JF-30 bunker fuel and Statfjord crude oil. Thick (1 mm) and thin (10 μm) oil films were exposed to artificial solar radiation in a 24 hour test program. The oil films were sampled individually at different points of time. The condition of oxidation was studied by means of the JR-analysis. The analysis showed the increased content of carbonyl in the thin film tests. The investigated content of carbonyl shows the level of aromatic hydrocarbon oxidation. The samples were investigated for the condition of biomarker composition together with a number of selected components by means of the GC/MS-analysis. The results were processed with the PC-based multivariate statistical analysis. The lacking influence of photooxidation in the biomarker structure was proved for the oils mentioned except for the Statfjord crude oil shown in the thin film test. The influence of evaporation existed in the lower part of the biomarker field. 12 figs., 4 tabs., 3 refs.

46606 (PB–90-240607/XAB) **Oil-spill risk analysis: Central and Western Gulf of Mexico (Proposed Lease Sales 123 and**

125) **Outer Continental Shelf. Final report.** Hannon, L.J.; Lear, E.M. Minerals Management Service, Herndon, VA (USA). Atlantic OCS Region. Jun 1990. 136p. (OCS/MMS–90/0040). Source: NTIS, PC A07/MF A01.

The Federal Government has proposed to offer Outer Continental Shelf lands in the Central and Western Gulf of Mexico for oil and gas leasing. Oil spills are a major concern associated with offshore oil production. In evaluating the significance of accidental oil spills, it is important to remember that the occurrence of such spills is fundamentally probabilistic. The effects of oil spills that could occur during oil and gas production must be considered. The report summarizes results of and oil spill risk analysis conducted for the proposed Gulf of Mexico Outer Continental Shelf Lease Sales 123 & 125. The objective of the analysis was to estimate relative risks associated with oil and gas production for the proposed lease sales.

46607 (PB–90-244039/XAB) **Health assessment for Double Eagle Refinery, Oklahoma City, Oklahoma County, Oklahoma, Region 6. CERCLIS No. OKD007188717. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 17p. Source: NTIS, PC A03/MF A01.

The Double Eagle Refinery, an Update 7 site National Priorities List, is located at 301 North Rhode Island Avenue, in southeastern Oklahoma City, Oklahoma County, Oklahoma. From 1929 to 1985, the site was operated as a facility for the refinement of used motor oil and other used petroleum products. Currently, the site is an inactive facility used for the storage of refinery tanks and equipment. Results of preliminary environmental monitoring programs indicate on-site sediment and sludge contamination and off-site soil contamination. Additional monitoring is needed to characterize the extent of on-site and off-site groundwater, soil, and sediments. Limited monitoring results indicate that contaminants from on-site sediments and sludge have migrated to off-site areas. The most likely pathways for human exposure to site contaminants are ingestion and dermal exposure to contaminated soil, sediments, and sludges. On the basis of preliminary sampling results, the site is a potential public health concern because of benzo(a)anthracene, cadmium, chromium, lead, polychlorinated biphenyls, toluene, total xylenes, and unspecified hydrocarbons.

46608 (PB–90-244112/XAB) **Health assessment for Prewitt Abandoned Refinery, Prewitt, McKinley County, New Mexico, Region 6. CERCLIS No. NMD980622773. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 20p. Source: NTIS, PC A03/MF A01.

The Prewitt Abandoned Refinery, an Update 7 site proposed for the National Priorities List, is located about one-half mile west of the Prewitt Post Office, McKinley County, New Mexico. The site consists of two separate parcels, one consisting of 68.2 acres and the other consisting of 6.8 acres. The site was operated as a crude oil refinery from 1939 to 1957 and is now abandoned. Although the site is located in a rural area, several off-site residences are located within 1,500 feet of the site. Benzene, toluene, xylene, polynuclear aromatic hydrocarbons, chromium, and lead were detected in on-site soil samples and on-site and off-site groundwater samples. Site-related contaminants have also been detected in off-site private wells. The most likely pathways for contaminants to migrate from on-site to off-site areas include those associated with groundwater and soil. Human exposure to site contaminants is most likely to occur via ingestion and inhalation of, or dermal contact with, contaminated groundwater and soil. The site is of potential public health concern because of elevated levels of contaminants in groundwater and soil.

46609 (PB–90-244203/XAB) **Guidance manual for petroleum-related LUST [Leaking Underground Storage Tank] cleanups in Illinois, Spring 1990. Interim report.** Pluymers, D.; Nash, H. Illinois Environmental Protection Agency, Springfield, IL (USA). Div. of Land Pollution Control. Mar 1990. 194p. (IEPA/LPC–90/47). Source: NTIS, PC A09/MF A02.

See also PB–90-125378. Errata sheet inserted.

The Guidance Manual, in its 2nd edition, explains the Illinois Environmental Protection Agency's (IEPA) Leaking Underground Storage Tank (LUST) Program. It is designed to assist the owners and operators of Illinois' underground storage tanks (USTs) in dealing with releases of petroleum products from their systems. The manual is presented in chronological step-by-step format so that tank owners and operators may easily fulfill the current requirements of the Illinois regulations and understand IEPA procedures. The manual covers all aspects of dealing with LUSTs, from how to determine if a release of a petroleum product has occurred, to how to clean-up the release and how to apply for reimbursement for corrective action costs from the Illinois Underground Storage Tank Fund.

46610 (PB–90-245275/XAB) **Assessing detoxification and degradation of wood-preserving and petroleum wastes in contaminated soil.** Aprill, W.; Sims, R.C.; Sims, J.L.; Matthews, J.E. Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. ©1990. 23p. (EPA–600/J-90/099). Source: NTIS, PC A03/MF A01.

Pub. in Waste Management and Research, Vol. 8, No. 1, 45-65(Feb 1990).

The study was undertaken to evaluate in-situ soil bioremediation processes, including degradation and detoxification, for wood preserving and petroleum refining wastos at high concentrations in an unacclimated soil. The soil solid phase, water soluble fractions of soil, and column leachates were evaluated. A mutagenic potential assay (Ames assay) and an aqueous toxicity assay (Microtox(TM) assay) were used to evaluate detoxification; high performance liquid chromatography was used to evaluate chemical concentration and degradation for eight polynuclear aromatic hydrocarbons (PAHs). The group of noncarcinogenic PAHs studied demonstrated greater degradation, ranging from 54-90% of mass added for the wastes; the carcinogenic group of PAHs studied exhibited degradation ranging from 24-53% of mass added. Although no mutagenicity was observed in waste/soil mixtures after one year, Microtox(TM) toxicity was observed in water soluble fractions and in leachate samples. Integration of information concerning degradation of hazardous constituents with bioassay information represents an approach for designing treatability studies and for evaluating effectiveness of in-situ soil bioremediation. When combined with information from waste, site, and soil characterization studies, data generated in treatability studies may be used in predictive models to: evaluate effectiveness of on-site soil bioremediation; develop appropriate containment structures to prevent unacceptable waste transport from the treatment zone; and design performance monitoring strategies.

46611 (PB–90-246620/XAB) **Health assessment for Pester Refinery, El Dorado, Butler County, Kansas, Region 7. CERCLIS No. KSD000829846. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 16 May 1990. 16p. Source: NTIS, PC A03/MF A01.

The Pester Refinery site has been proposed for listing on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA). The site, located in the vicinity of an active oil refinery, is known as a burn pond; it had been used as a retention basin for storm water and for disposal of separator sludge from the adjacent refinery. The site is in a mainly rural area, although the town of El Dorado is within a 3-mile radius. Demographic data are not available. Past disposal practices have resulted in contamination of on- and off-site groundwater, surface water, soil, sediment, and sludge. Based on information reviewed, the Agency for Toxic Substances and Disease Registry (ATSDR) has concluded that this site is of potential public health concern because of the risk to human health resulting from possible exposure to hazardous substances at concentrations that may result in adverse human health effects. As noted in the Human Exposure Pathways Section, human exposure to heavy metals may be occurring and may have occurred in the past via ingestion of and dermal contact with contaminated groundwater, surface water, soil, sediment, and sludge. Recommendations are made concerning additional monitoring, determination of groundwater and surface water use in the area, surface water protection, and worker protection during hazardous waste activities.

46612 (PB–90-250416/XAB) **Health assessment for Rio Grande Oil Company Refinery (Rio Grande I), National Priorities List, Sour Lake, Texas, Region 6. CERCLIS No.**

TXD980795736. Preliminary report. Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 16 May 1990. 25p. Source: NTIS, PC A03/MF A01.

The Rio Grande Oil Company Refinery (Rio Grande I) site is a proposed National Priorities List site located adjacent to the City of Sour Lake in Hardin County, Texas. Rio Grande I was the site of an oil refinery in the 1920s and 1930s. Refinery wastes were disposed of on site in open, unlined pits. A privately-funded remediation effort removed 3,410 cubic yards of waste material from the site in November 1987. Elevated levels of mercury, zinc, and bis(2-ethylhexyl)phthalate were detected in soil on site after remediation. No groundwater contamination was detected. Based on the available environmental sampling information, the Rio Grande I site is not of public health concern under current conditions.

0210 Legislation and Regulations

Refer also to citation(s) 46596, 46614

46613 (DOE/CH/10381–7) **State uses of Exxon and Stripper Well oil overcharge funds: Status report No. 7.** Gonzales, H.; Soifer, J.; Janis, L. National Consumer Law Center, Washington, DC (USA). ©Jul 1990. 93p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG02-88CH10381. Source: The National Consumer Law Center, 236 Massachusetts Avenue, N.E., Washington, D.C. 20002.

Since March of 1986, state governments have received roughly $3.46 billion in funds obtained by the federal government through two major cases, based on price overcharges committed by numerous oil companies during the period of price controls, between 1973 and 1981. Furthermore, about another $1 billion may still be collected from oil companies, with roughly 1/2 to be distributed to the states (and the other 1/2 to the federal government), over the next 5 to 10 years. The role of state government is to allocate the funds, within the specific case guidelines, to new or existing energy programs, in a way which is designed to benefit (or provide restitution to) the class or classes of purchasers who bore the burden of the overcharges. This report incorporates information collected by NCLC through telephone surveys conducted during July, 1990. The information we collected on the status and state uses of both Exxon and Stripper Well funds is contained in the state-by-state narrative summary section and in a series of tables at the end of the report. Each of the quarterly reports tracks final state decisions allocating use of these funds. The terms "allocated" and "designated" are used interchangeably throughout the document to mean that final state decisions have been made regarding these funds. Tracking state allocations about these funds is the only practical way for us to provide an overview of the actual status of state processes or decisions which have occurred with regard to this money. 8 tabs.

0220 Transport, Handling, and Storage

Refer also to citation(s) 46609

46614 (GAO/T-RCED-90-55) **Adequacy of the regulatory oversight of the Trans-Alaska pipeline and terminal.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 8p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

The Exxon Valdez spill abruptly brought to the nation's attention the risks of transporting crude oil. While oil tanker transportation received many of the headlines, the safety of pipelines carrying oil and the terminals that store it have also been called into question. GAO testified on the adequacy of regulatory oversight of the 800-mile Trans-Alaska Pipeline System and the terminal at Valdez, Alaska. This paper reports increased and coordinated regulatory oversight as a major component of an effective operational and emergency response strategy for the pipeline. The current lack of comprehensive and systematic oversight is of particular concern because of recent revelations of significant corrosion problems in the pipeline.

46615 (PB–90-246182/XAB) **Overview of EPA research on underground-storage-tank leak detection.** Rosenberg, M.S.; Nault, J.M.; Tafuri, A.N. Camp Dresser and McKee, Inc., Boston, MA (USA). 1989. 25p. Contract EPA-68-03-3409. Source: NTIS, PC A03/MF A01.

Research for leak detection at underground storage tank systems (USTs) is being carried out at two Offices of Research and Development (ORD) laboratories within EPA's organization. The Edison, New Jersey lab – the Risk Reduction Engineering Laboratory – focuses its attention on internal detection methods. Its primary objective to date has been to determine the performance capabilities of volumetric tank testing devices in terms of probability of detection and probability of false alarm. The Las Vegas, Nevada lab – the Environmental Monitoring Systems Laboratory – addresses external detection devices. The work has thus far consisted of the development of test methods to enable manufacturers of external monitoring devices to determine the performance of their equipment in terms of specificity, accuracy, response time, detection limits, drift, and interferences. Results of EPA research efforts have contributed to the development of the Technical Standards for UST regulations, enacted in September 1988.

0230 Properties and Composition

Refer also to citation(s) 46581, 47314, 47564

46616 (DOE/ER/13702–3) **A model approach to vanadium in crude oils and their refining: Progress report.** Christou, G. Indiana Univ., Bloomington, IN (USA). Dept. of Chemistry. [1990]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13702. Order Number DE90016605. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The driving force behind our current interest in vanadium/oxygen and vanadium/sulfur chemistry is the relevance of this area to certain processes in the petroleum industry, specifically crude oil refining. Crude oils contain varying levels of organically-bound sulfur (thiophenes, thiols and disulfides) and metals (principally V, Ni and Fe). The metals are part of the organic phase of the oil, not merely physically mixed-in, as are dispersed mineral particles. The concentration of these organically-bound metal impurities can range from as low as a few ppM to well over 1000 ppM in crudes such as Boscan from Venezuela. In the conversion of crude oils to transportation fuels, the metal species are considered undesirable components and must be removed for upgrading. In essence, our efforts during the previous proposal period have been directed toward elucidating the structural and reactivity chemistry of vanadium/oxygen [VO^{2+}] and vanadium/sulfur species to increase our understanding of this area and to allow our knowledge of the mechanistic chemistry of the industrial process. Our efforts can be broken down into the following areas: (1) new types of VO^{2+} species, (2) reactivity characteristics of VO^{2+} species, (3) V/S/N complexes and V/S clusters. Our progress in each area will be described in turn.

0250 Combustion

46617 Kinetic modeling of large hydrocarbon fuel molecules. Westbrook, C.K. (Lawrence Livermore National Lab., Livermore, CA (US)); Pitz, W.J. pp. 117-120 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

Hydrocarbon fuels used in practical combustion systems are often complex mixtures of a variety of different molecules, many consisting of large alkane and aromatic species. The authors discuss the importance of fuel molecule size and structure in determining combustion properties. The development of a kinetic model of large hydrocarbon fuel molecules is described.

46618 Resonance fluorescence imaging of CH in hydrocarbon flames using a polaroid filter to reject Rayleigh scattered light. Dibble, R.W. (Combustion Research Facility, Sandia National Lab., Livermore, CA (US)); Schmitt, R.L.; Barlow, R.S.; Fourgette, D.C. pp. 188-194 of Proceedings of the optical methods in flow and particle diagnostics, ICALEO '89: LIA Volume 68. Laser Institute of America, Toledo, OH (USA) (1989). (CONF-891091–: 8.

international congress on applications of lasers and electro-optics (ICALEO '89), Orlando, FL (USA), 15-20 Oct 1989).

This paper discusses electronic imaging of laser induced fluorescence from a plane of laser light that intersects a reactive flow. The case of resonance fluorescence is explained. Rotation of the polaroid filter is explained.

46619 Relation between group combustion and drop array studies. Ryan, W. (Mechanical Engineering, Texas A and M Univ., College Station, TX (US)); Annamalai, K.; Caton, J. pp. 261-268 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446--: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper relates the correction factors obtained using the group combustion model to those correction factors which have been obtained for three to nine droplet arrays, and presents a method of obtaining the correction factor for transient evaporation/combustion involving a two phase mixture of drops/particles and air. The results presented in this paper are useful in accounting for the interactive effects between the drops/particles when spray combustion is modeled.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 46488

46620 (DOE/MC/24157–2845) **Reservoir analysis of blanket sands using a numerical multi-mechanistic model: Final report.** Ertekin, T.; Adewumi, M.A.; Bezilla, M. Pennsylvania State Univ., University Park, PA (USA). Oct 1989. 97p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-87MC24157. Order Number DE90009658. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The primary objective of this research is to conduct a comprehensive analysis of the flow of gas in the tight blanket sands of the Mesaverde formation with the intent of fostering a better understanding of the physics governing such flow. The project is made up of three main task: reservoir data collection and analysis for the blanket sands; development, testing and validation of the multi-mechanistic reservoir model proposed to be used in this study; and the utilization of the model to evaluate production schemes and the evolution of an optimized scheme for the blanket sands. The expected deliverables from this study include: a coagulative analysis of the available reservoir analysis data and field data obtained by DOE in a manner that makes them more amenable to utilization and interpretation; a model that is coded and documented which will serve the primary purpose of a descriptive and predictive tool for natural gas production from tight blanket formations; and an in-depth analysis of the reservoir performance, productivity prediction, production decline curves under various production schemes with a view of devising the optimum production scheme for these formations. 45 refs., 33 figs., 12 tabs.

46621 (NEDO-P–8920) **Trend investigation of coalbed methane gas.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 203p. (In Japanese). Order Number DE90517224. Source: NTIS (US Sales Only), PC A10/MF A01.

The present report investigated exploration and production system of coalbed methane gas, non-conventional type gas, existing, in large quantity, in large scale coal mine area. In the USA, coalbed methane gas has been made in investigation and research since 1974. Importance is attached to well stimulation and hydraulic pressure fracture method to artificially form fracture by giving, in order to heighten the productivity of gas, hydraulic pressure to coalbed. For coalbeds in coal mine area, those which are in high permeability area with fracture, developed in the natural state, are seldom seismically explored. The exploration and production system of coalbed methane gas necessitates technical development, in series, of geological survey, seismic wide area survey, high permeability coalbed area location, wildcat gas production prove test, heightening in productivity of gas by well stimulation, multi-seam completion, etc. Australia is a virgin soil of coalbed methane gas and can be an appropriate object in order for Japan to proceed with technical development. 86 refs., 131 figs., 14 tabs.

0303 Drilling, Production, and Processing

Refer also to citation(s) 46376, 46620

46622 (PB–90-244377/XAB) **Coalbed Methane Production and Stimulation (COMPAS II) Data Base: Documentation and user's manual. Topical report, April 1990.** Sinha, K.P.; Bell, G.J.; Odette, B.B.; McLennan, J.D.; Jones, A.H. Terra Tek, Inc., Salt Lake City, UT (USA). Apr 1990. 120p. Contract GRI-5087-214-1460. (TR–90-126). Source: NTIS, PC A06/MF A01.

See also PB–88-220017.

Coalbed Methane Production and Stimulation II (COMPAS-II) is a Micro-Computer based Database Management Program, developed as a tool for providing a systematic source of information on the Oil and Gas wells, their drilling and completion details, zonal geology, as well as stimulation and production data. General (well summary and zone characteristics) information on more than 300 coalbed methane production wells drilled in North America already exist in the data base. For approximately half the number of wells entered in the database, stimulation and production data also exist. COMPAS is a menu-based, user-friendly program operating under the commercially available Data-Base Management System REVELATION - Version G.2. The program offers a variety of sort-list operations, data input and viewing, printing data in report forms and plotting of treatment and production data. It is expected that COMPAS will prove to be not only a research tool, but of considerable usefulness in routine design and operation.

46623 The Multiwell Experiment: A field laboratory in tight gas sandstone reservoirs. Northrop, D.A. (Sandia National Labs., Albuquerque, NM (USA)); Frohne, K.H. *Journal of Petroleum Technology (USA)*, 42(6): 772-779 (Jun 1990). DOE Contract AC04-76DP00789.

This paper reports on the U.S. DOE's Multiwell Experiment (MWX), a field laboratory aimed at improved characterization and gas production from low-permeability reservoirs typified by the Mesaverde Group in western Colorado. A broad spectrum of activities was conducted over 8 years at a site containing three closely spaced (< 225 ft [< 68 m]), deep (7,500 to 8,350 ft [2300 to 2550 m]) wells. The results yield insights and contributions into the technology of gas production from this resource.

0306 Economic, Industrial, and Business Aspects

46624 (ANL/EAIS/TM–21) **Natural gas market expansion and delivery infrastructure costs: Case study of New England.** Guldmann, J.M. Argonne National Lab., IL (USA). Environmental Assessment and Information Sciences Div. Jun 1990. 283p. Sponsored by U.S. DOE Office of Policy, Planning and Analysis. DOE Contract W-31109-ENG-38. Order Number DE90016698. Source: NTIS, PC A12/MF A01 - OSTI; GPO Dep.

Substituting natural gas for oil is viewed as a promising way to reduce the growing US dependency on oil imports as well as to mitigate the negative environmental impacts resulting from oil burning, such as acid rain and global warming. However, infrastructure impediments might prevent natural gas from achieving its optimal market share, as illustrated by the fact that two-thirds of the 12.1 million homes using an oil product for space heating have no access to a gas line and account for 50% of the total residential oil use. The Northeast is clearly one of the US regions most severely handicapped by either the total lack of a gas transmission and distribution infrastructure or capacity shortages in the existing infrastructure, particularly in the New England states. The purpose of this study is to assess (1) the potential for growth of the natural gas market in New England, (2) the need for expanding the gas delivery infrastructure within and outside New England as a prerequisite to this growth, and (3) the incremental infrastructure costs of such growth, and thus its economic feasibility. 41 refs., 16 figs., 76 tabs.

0308 Environmental Aspects

Refer also to citation(s) 46606

46625 (UCRL-CR-104316) **Falcon series data report: 1987 LNG vapor barrier verification field trials.** Brown, T.C.; Cederwall, R.T.; Chan, S.T.; Ermak, D.L.; Koopman, R.P.; Lamson, K.C.; McClure, J.W.; Morris, L.K. Lawrence Livermore National Lab., CA (USA). Jun 1990. 661p. Sponsored by U.S. Department of Transportation; Gas Research Institute. DOE Contract W-7405-ENG-48. (GRI-89/0138). Order Number DE90016474. Source: NTIS, PC A99/MF A01 - OSTI; GPO Dep.

A series of five Liquefied Natural Gas Spills up to 66 m^3 in volume were performed on water within a vapor barrier structure at Frenchman Flat on the Nevada Test Site as a part of a joint government/industry study. This data report presents a description of the tests, the test apparatus, the instrumentation, the meteorological conditions, and the data from the tests. 16 refs., 27 figs., 8 tabs.

0320 Transport, Handling, and Storage

46626 (LBL-28594) **Feasibility analysis and development of foam protected underground natural gas storage facilities: Final report, January 1986-June 1989.** Witherspoon, P.A.; Benson, S.; Persoff, P.; Pruess, K.; Radke, C.J.; Wu, Yu-shu. Lawrence Berkeley Lab., CA (USA). Feb 1990. 321p. Sponsored by Gas Research Institute. DOE Contract AC03-76SF00098. Contract 5086-271-1160. Order Number DE90014886. Source: NTIS, PC A14/MF A01 - OSTI; GPO Dep.

Two causes of poor recoverability of gas stored in aquifers are migration of gas far from the injection well and upward coning of water into withdrawal wells. Laboratory experiments and numerical simulations were conducted to study the possible use of aqueous foams to block the flow of gas or liquid to ameliorate these problems. Experiments in sandstone cores at simulated reservoir conditions showed that foam reduces the permeability to gas and liquid by typically three orders of magnitude. The rheology of foam was also investigated. It was found that steady-state pressure gradients for foam are practically independent of gas velocity but increase nearly linearly with increasing liquid velocity. This flow behavior is rationalized in terms of changes in bubble texture. A numerical simulation study showed that water coning could be significantly delayed by placing a horizontal foam lens just above the gas-water interface. Also discussed in the report are conditions for forming foam in situ, the feasibility of emplacing of foam bank, and the durability of permeability reduction. Laboratory experiments and numerical simulation indicate the potential for significantly improving the efficiency of aquifer gas storage with aqueous foams. A field trial of foam to diminish water coning is recommended. 15 refs., 24 figs., 8 tabs.

46627 (PB-90-247222/XAB) **Constant tensile load test for qualification or acceptance testing of PE gas pipe. Topical report, January 1984-December 1987.** Hulbert, L.; Derringer, G.; Cassady, M. Battelle Columbus Div., Washington, DC (USA). Aug 1988. 177p. Contracts GRI-5084-271-0972, GRI-5085-271-1113. Source: NTIS, PC A09/MF A01.

It was found that the Constant Tensile Test Load (CTL) test can be used for accelerated qualification or acceptance testing of polyethylene (PE) gas pipe. Immersing loaded test specimens in Igepal at 35 C produced failures in a short time. Changes in resin or processing that affect the brittle slow crack growth resistance should be detected by the CTL test, as shown by reports in the literature and tests and analysis by Battelle and Argonne National Laboratory. Using the CTL test as a qualification test may involve measuring the ductile and brittle failure times at different stress levels using specimens of several lots of pipe of the same size and resin made by the same manufacturer. These test results can be used by the utility as a part of the evaluation and qualification process for judging new gas pipe. An acceptance test is proposed for currently installed PE gas pipes in which 5 specimens are placed on test in Igepal at 35 C at nominal stresses equaling the lesser of 33% of yield or 1000 psi. If none of the specimens fail in 48 hours, the pipe may be judged acceptable. Alternatively, the specimens can be kept on load to failure and the failure times compared with the test specimens for previously tested lots.

46628 (PB-90-247271/XAB) **Evaluation of cased and uncased gas distribution and transmission piping under railroads and highways, Phase 2. Annual report, November 1987.** O'Rourke, T.D.; Stewart, H.E.; Ingraffea, A.R.; Nyman, K.J.; Crossley, C.W. Cornell Univ., Ithaca, NY (USA). Dept. of Structural Engineering. Nov 1987. 147p. Contract GRI-5085-271-1147. Source: NTIS, PC A07/MF A01.

A comprehensive methodology is being developed for evaluating stresses in natural gas pipelines at railroad and highway crossings. The methodology accounts for soil-structure interaction and the three-dimensional distribution of pipeline stresses. The methodology involves delineating field loads and geometries through detailed site observations and discussions with industry personnel, and using computer graphics to analyze pipeline stresses under the complex three-dimensional conditions which prevail in the field. Field experiments will be performed to substantiate the predicted pipeline stresses at railroad crossings. Guidelines will be developed for pipeline crossings acceptable to representatives of gas, railroad, and highway industries.

0340 Combustion

46629 (AD-A-222456/6/XAB) **Performance of a condensing heat exchanger in recovering waste heat from a natural gas-fired boiler. Final report.** Case, M.P.; DeVelle, S.; Caron, R.; Pierce, E.T. Army Construction Engineering Research Lab., Champaign, IL (USA). May 1990. 26p. (CERL-TR-E-90/09). Source: NTIS, PC A03/MF A01.

The performance of boiler heat exchangers is limited by the need to keep the flue gas temperature above its dew point to avoid condensation of corrosive acids. However, latent heat can be recovered at temperatures below the dew point of the gas by protecting the heat exchanger tubes from the acids. A new Teflon covering process demonstrates significant advantages over older coating technologies. To evaluate the effectiveness of this new Teflon covering for use in Army boilers, researchers selected the Louisiana Army Ammunition Plant (LAAP) as a demonstration site. A natural gas firetube boiler with a nominal firing rate of 20.5 million British thermal unit per hour (MBtu/h) and less than 10 percent condensate return was fitted with a Teflon-covered condensing heat exchanger to preheat makeup water. Tests were run to determine fuel consumption with and without the heat recovery system operating.

46630 Pdf modeling of turbulent nonpremixed methane jet flames. Chen, J. (Combustion Research Facility, Sandia National Lab., Livermore, CA (US)); Dibble, R.W.; Kollmann, W. pp. 135-140 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446-: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper presents an expanded model of turbulent nonpremixed combustion. Two plausible chemical reaction models are considered: a five-scalar, four-step, reduced reaction mechanism, and a four-scalar constrained equilibrium model. Detailed comparisons of model predictions with laser Raman experimental data reveal that the model fails to predict greater departure from chemical equilibrium as mixing rates are increased. This failure is due to the deficiency of the current mixing model in treating the interactions between the turbulent mixing and combustion.

46631 Chain mechanisms in the overall reaction orders in laminar flame propagation. Egolfopoulos, F.N. (Dept. of Mechanical and Aerospace Engineering, Princeton Univ., Princeton, NJ (US)); Law, C.K. pp. 129-134 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446-: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses the laminar flame speeds of methane/oxygen/nitrogen mixtures as functions of the flame temperature T_f

and system pressure p which have been experimentally determined by using the counterflow, twin-flame technique. These data are then compared with numerically-calculated values obtained by using an independently-validated scheme. Results show that the overall reaction order n and activation energy E_a are far from being constants, that n decreases with increasing p, and that n can actually assume negative values; the last result implies that the mass burning rate of some weakly- burning flames may decrease with increasing pressure. By further identifying the crucial reaction steps through sensitivity analysis, results are interpreted on the basis of the influence of chain branching-termination mechanisms on the overall reaction rate.

04 OIL SHALES AND TAR SANDS

0402 Reserves, Geology, and Exploration

Refer also to citation(s) 46623

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 46519, 46554

46632 A comprehensive approach to in-situ combustion modeling. Belgrave, J.D.M. (Univ. of Calgary, Alberta (Canada)); Moore, R.G.; Ursenbach, M.G.; Bennion, D.W. pp. 751-762 of SPE/DOE seventh symposium on enhanced oil recovery: Proceedings. EOR [enhanced oil recovery] in the 1990's: Global prospects and perspectives. Society of Petroleum Engineers, Richardson, TX (US) (1990). (CONF-900426--: 7. SPE/DOE symposium on enhanced oil recovery, Tulsa, OK (USA), 22-25 Apr 1990).

Low temperature oxidation (LTO) has long been recognized as one of the dominant mechanisms controlling fuel availability in in-situ combustion. Its effect on the physical properties of crude oils is also well known. In spite of these findings, the prevailing conceptual model of in-situ combustion still hinges on thermal cracking (in isolation) ahead of the firefront, to provide sufficient fuel (coke) for propagation of the reaction zone. Previous simulation studies, which purported to include LTO as part of the reaction scheme, have unrealistically specified the reaction products as carbon oxides and water. Furthermore, oil compositional changes due to oxidation have been completely neglected. This paper describes a unified pseudo-mechanistic reaction model for mathematical modeling of in-situ combustion of Athabasca bitumen. The model represents a consolidation of individual experimental kinetic studies on thermal cracking and low temperature oxidation of Athabasca bitumen, and reported data for the high temperature oxidation of coke. The formulation is comprehensive in that it allows bitumen to undergo density and viscosity increases as well as reduced reactivity to oxidation, with increased oxidation extent. Hydrocarbon bypassing due to quenching of the combustion front is also permitted with the proposed kinetic model. The paper includes application of the reaction model in numerical simulations of adiabatic combustion tube tests performed on Athabasca bitumen. A significant feature of the model is its ability to predict the dual oxidation uptake peaks associated with ramped temperature oxidation experiments.

0405 Properties and Composition

Refer also to citation(s) 46623

0409 Waste Management

46633 Treatment of concentrated industrial wastewaters originating from oil shale and the like by electolysis polyurethane foam interaction. Tiernan, J.E. To Dept. of Energy, Washington, DC (USA). USA Patent 4,929,359/A/. 29 May 1990. Filed date 26 Jan 1988. USA Patent Application 7-148,721. Int. Cl. C02F 1/28. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes highly concentrated and toxic petroleum-based and synthetic fuels wastewaters such as oil shale retort water which are treated in a unit treatment process by electrolysis in a reactor containing oleophilic, ionized, open-celled polyurethane foams and subjected to mixing and laminar flow conditions at an average detention time of six hours. Both the polyurethane foams and the foam regenerate solution are re-used. The treatment is a cost-effective process for waste-waters which are not treatable, or are not cost-effectively treatable, by conventional process series.

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 47443

46634 (CDTN-DERL-PD-032/82) **Radiometric survey in sampling areas of Itataia mine ore and radiometric monitoring in Itataia project sites.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Jul 1982. 30p. (In Portuguese). Order Number DE90639659. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This radiometric survey was done by CDTN, in Itataia sites, on July/82 and it aimed fundamentally to evaluate local radiological conditions, as for aspect of occupational radiation protection. Besides of results obtained, this report has informations of general aspects that ought to serve as subsidies for elaboration of radiological protection program of local. (author).

46635 (DOE/EIA-0478(89)) **Uranium industry, annual 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 31 Aug 1990. 121p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90017413. Source: NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

The Uranium Industry Annual (UIA) provides current statistical data on the US uranium industry for the Congress, Federal and State agencies, the uranium and electric utility industries, and the public. 20 figs., 50 tabs.

0504 Feed Processing

Refer also to citation(s) 46643, 47914

46636 (CDTN-430) **Continuos extraction of uranium and molibdenum by lixiviation with sulfuric acid.** Cripiani, M. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1980. 26p. (In Portuguese). Order Number DE90639441. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A methodology for collecting data of uranium and molibdenum extraction by lixiviation with sulfuric acid is showed. Discontinuous tests of lixiviation, time influence, temperature, granulation, acid/ore relation, oxidant/ore relation and solid percentage are studied. (C.G.C.).

46637 (CDTN-431) **Solvent extraction of uranium and molybdenum in sulfuric media.** Duarte Neto, J. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1980. 127p. (In Portuguese). Order Number DE90639442. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

A Solvent extraction process for recovering the uranium and molybdenum from the sulfuric acid solution produced from Figueira ores was developed. The leach solution contains molybdenum with a mean ratio Mo/U = 35%. THe solvent used was a tertiary amine-Alamine 336, modified with tridecanol in querosine. An investigation was made to evaluate the variables affecting the extraction and stripping of uranium and molybdenum. The Alamine 336 showed a significant extraction power for uranium and molybdenum. In the stripping step of uranium using acidified sodium cloride it was observed the presence of an insoluble amine-molybdenum-arsenic complex. (author).

46638 Preparation of uranium dioxide reactor fuel feedstock. Tinkle, M.C. (Los Alamos National Laboratory, NM (USA)); Hayes, T.A.; Vigil, E.J. pp. 30, Paper NUCL 103 of American Chemical Society, Division of Nuclear Chemistry and Technology, national meeting. American Chemical Society, Washington, DC

(US) (1989). (CONF-8904152--: American Chemical Society Division of Nuclear Chemistry and Technology, Dallas, TX (USA), 9-14 Apr 1989).

A UO_2 feedstock was required for the production of uranium nitride reactor fuel for the SP-100 space reactor. Methods were developed for producing kilogram quantities of UO_2 feedstock using standard laboratory equipment and also for producing the equivalent product using more advanced equipment. The feedstock was prepared as both depleted and enriched UO_2. Precipitated $UO_4 \cdot XH_2O$ was prepared under closely regulated pH control to determine the sinterability and reactivity of the UO_2 feedstock powder. The precipitate was separated from solution by filtration and calcined at 900°C to U_3O_8 before being converted to an activated UO_2 through a reduction and activation cycle. The resulting UO_2 fuel feedstock contained about 88 wt% uranium and had a bulk density of $\leq$2.5 g/cm^3.

0507 Fuels Production and Properties

Refer also to citation(s) 46836, 46838, 46881, 47127, 47167, 47188, 47189, 47190, 47270, 47272, 47273, 47284, 47364

46639 (LBL--26455, pp. 97) **Reaction and thermal accommodation of gases with liquid uranium and two uranium alloys.** Olander, D.R.; Balooch, M.; Siekhaus, W.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The reactions and the thermal accommodation of CO, CO_2, N_2, CH_4, and C_2H_2 with liquid uranium and of CO, O_2, and H_2O with (U,Fe) and (U,Cr) alloys were studied by modulated molecular-beam mass-spectrometric methods using the appearance of a reaction product or the disappearance of the reactant to determine the reaction probability. Temperatures up to 1,500 K were investigated. The reaction probabilities of CO, N_2, and CH_4 were below the detection limit ($<10^{-3}$). The C_2H_2 and CO_2 reaction probabilities were found to be 0.7 and 0.03, respectively. Liquid uranium alloys exhibited the same reactivities with CO_2 and O_2 as pure uranium. The reaction probabilities of H_2O with the liquid alloys, however, were about a factor of two lower than that of uranium. The thermal-accommodation coefficient ranged from 0.1 for CO and CO_2, to 0.3 for C_2H_2 and CH_4, and to 0.6 for O_2 and H_2O.

46640 (WHC-SA--0658) **Plutonium finishing plant remediation project: Exhaust manifold.** Westsik, G.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1990. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-9007106--54: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90015375. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Plutonium Finishing Plant Remediation Project was initiated in 1988 to formalize, dedicate, and separately fund ongoing maintenance and safety programs for remedial action on ductwork and service piping at the Plutonium Finishing Plant (PFP). Specific near-term remedial actions include removal or replacement of selected ventilation ductwork and process vacuum piping with associated plutonium recovery operations. Other activities include enhanced monitoring of selected ventilation ductwork, process vacuum piping, filter rooms and characterization of plutonium residues on interior surfaces of the exhaust stack manifold downstream of final high-efficiency particulate air (HEPA) filtration. This report serves as an introduction to the Building 234-5Z portion of the Remediation Project and provides a current status on characterization activities pertaining to plutonium residues on interior surfaces of the exhaust stack manifold. 1 tab.

46641 **Process for making a martensitic steel alloy fuel cladding product.** Johnson, G.D.; Lobsinger, R.J.; Hamilton, M.L.; Gelles, D.S. To Dept. of Energy, Washington, DC (USA). USA Patent 4,927,468/A/. 22 May 1990. Filed date 30 Nov 1988. USA Patent Application 7-278,068. Int. Cl. C21D 9/00. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a very narrowly defined martensitic steel alloy fuel cladding material for liquid metal cooled reactors, and a process for making such a martensitic steel alloy material. The alloy contains about 10.6 wt. % chromium, about 1.5 wt. % molybdenum, about 0.85 wt. % manganese, about 0.2 wt. % niobium, about 0.37 wt. % silicon, about 0.2 wt. % carbon, about 0.2 wt. % vanadium, 0.05 maximum wt. % nickel, about 0.015 wt. % nitrogen, about 0.015 wt. % sulfur, about 0.05 wt. % copper, about 0.007 wt. % boron, about 0.007 wt. % phosphorus, and with the remainder being essentially iron. The process utilizes preparing such an alloy and homogenizing the alloy at about 1000° C for 16 hours; annealing the homogenized alloy at 1150° C for 15 minutes; and tempering the annealed alloy at 700° C for 2 hours. The material exhibits good high temperature strength (especially long stress rupture life) at elevated temperature (500°--760° C).

0508 Spent Fuels Reprocessing

46642 (CEA-CONF--9973) **Synthesis and uses of the amides extractants.** Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. de Genie Radioactif); Thiollet, G. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif. 1989. 17p. (CONF-890401--: 197. national meeting of the American Chemical Society, Dallas, TX (USA), 9-14 Apr 1989). Order Number DE90511933. Source: NTIS (US Sales Only), PC A03/MF A01.

Carboxylic acids amides (RR'NCOCR"), malonic acid amides (RR'NCOCH$_2$CONRR') and substituted malonic acid amides (RR'NCOCHR" CONRR') are extractants of the actinides ions. They show good prospects for use in the nuclear industry because of their complete incinerability. In addition, their degradation products interfer much more less in the separation processes when compared with organophosphorus extractants. The synthesis and the purification of two typical extractants: N-N-di (2-ethylhexyl) butyramide ($C_4H_9CHC_2H_5CH_2)_2NCOC_3H_7$ and N,N'-dimethyl N,N'-dibutyl 1.3 diamide 2(3-oxa)nonyl propane $(C_4H_9CH_3NCO)_2CHC_2H_4OC_6H_{13}$ are described. The purities, checked by NMR, elemental analysis and potentiometry, were in the range 98 to 99.5%. The yields for monoamides were in the range 70 to 90% and for the diamides 20 to 40%. 3 figs, 3 tabs, 10 refs.

46643 (CONF-9005161--) **Actinide separations conference.** Oak Ridge National Lab., TN (USA). [1990]. 44p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 14. Gatlinburg actinide separations conference; Gatlinburg, TN (USA); 14-17 May 1990. Order Number DE90016541. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report contains the abstracts for 55 presentations given at the fourteenth annual Actinide Separations Conference. (JDL)

46644 (IPEN-PUB--167) **Mixer-settler performance evaluation in actinide extraction.** Camilo, R.L.; Goncalves, M.A.; Carvalho, E.I.; Nakazone, A.K.; Araujo, B.F. de; Araujo, J.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 13p. (In Portuguese). Order Number DE90639443. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This paper deals with four conceptions of mixer-settlers used for actinide purification and recovery. By means of the uranium concentration profiles in the organic and aqueous phases, the evaluation of each mixer-settler was made. The main purpose of this work is the data acquisition, for adapting the different contactor types to actinide recovery by liquid-liquid extraction, in the nuclear fuel cycle. (autor).

46645 (WHC-EP--0339) **High-resolution inductively coupled plasma-atomic emission spectrophotometric analysis of PUREX [Plutonium-Uranium Extraction] head-end solutions.** Douglas, J.G. Westinghouse Hanford Co., Richland, WA (USA). May 1990. 19p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. Order Number DE90014764. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

High-resolution inductively coupled plasma-atomic emission spectrophotometry has value as a method for the rapid determination of total plutonium and $^{240}/^{239}$Pu ratios. High-resolution inductively coupled plasma-atomic emission spectrophotometry has

been compared to isotope-dilution mass spectrometry, the standard accountability method for determining total plutonium and plutonium isotopic distributions, using a sample of dissolved N-Reactor fuel from the Plutonium-Uranium Extraction Plant head-end E6 tank. Of the two methods, isotope-dilution mass spectrometry has better analytical accuracy, precision, and detection limits, while high-resolution inductively coupled plasma-atomic emission spectrophotometry has shorter sample preparation and analytical turnaround times (4 to 8 hours). Therefore, high-resolution inductively coupled plasma-atomic emission spectrophotometry will be more valuable as a rapid screening method to generate process control and preliminary accountability data than as a competitive replacement for isotope-dilution mass spectrometry. This should be especially true in relatively uranium-free process streams such as those in the plutonium finishing and recovery processes. 4 refs., 4 figs., 10 tabs.

46646 Centrifugal contactor modified for end stage opertion in a multistage system. Jubin, R.T. To Dept. of Energy, Washington, DC (USA). USA Patent 4,925,441/A/. 15 May 1990. Filed date 13 Jun 1989. USA Patent Application 7-365,636. Int. Cl. B04B 5/00. 16p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a cascade formed of centrifugal contactors useful for countercurrent solvent extraction processes such as utilizable for the reprocessing of nuclear reactor fuels is modified to permit operation in the event one or both end stages of the cascade become inoperative. Weir assemblies are connected to each of the two end stages by suitable conduits for separating liquids discharged from an inoperative end stage based upon the weight of the liquid phases uses in the solvent extraction process. The weir assembly at one end stage is constructed to separate and discharge the heaviest liquid phase while the weir assembly at the other end stage is constructed to separate and discharge the lightest liquid phase. These weir assemblies function to keep the liquid discharge from an inoperative end stages on the same weight phase as would occur from an operating end stage.

0509 Transport, Handling, and Storage

Refer also to citation(s) 47376

46647 (DOE/AL/58309–46) **Risk analysis of the transport of contact handled transuranic (CH-TRU) wastes to Waste Isolation Pilot Plant (WIPP) along selected highway routes in New Mexico using RADTRAN 4.** Gallegos, A.F.; Channell, J.K. Environmental Evaluation Group, Albuquerque, NM (USA); Environmental Evaluation Group, Carlsbad, NM (USA). Aug 1990. 57p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-89AL58309. (EEG–46). Order Number DE90017272. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report analyzes the radiological health effects, and, to a lesser extent, the economic impacts of transporting contact-handled transuranic (CH-TRU) waste from 10 generator sites in the USA to the Waste Isolation Pilot Plant (WIPP). The effects of transporting remote-handled transuranic (RH-TRU) waste to WIPP are not addressed because the US Department of Energy (DOE) does not have plans to ship this type of waste during the Test Phase. The intent of this report is to place into perspective the risk of radiation from both "incident free" exposure, and exposures resulting from a release of radioactivity from a TRUPACT-II container(s) as a result of a highway accident. Only the routes identified in the Supplemental Stipulated Agreement (SSA) between the state of New Mexico and DOE (1982) were analyzed for this report. An adequate database to compare the alternate routes with SSA routes was not available for this analysis. 17 refs., 3 figs., 15 tabs.

46648 (PNL-SA–18412) **Alternatives for packaging and transport of greater-than-class C low-level waste.** Smith, R.I. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007106–66: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016559. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Viable methods for packaging greater-than-class C (GTCC) low-level wastes and for transporting those wastes from the waste generator sites or from an eastern interim storage site to the Yucca Mountain repository site have been identified and evaluated. Estimated costs for packaging and transporting the population of GTCC wastes expected to be accumulated through the year 2040 have been developed for three waste volume scenarios, for two preferred packaging methods for activated metals from reactor operations and from reactor decommissioning, and for two packaging density assumptions for the activated metals from reactor decommissioning. 7 refs. 7 tabs.

46649 Advances in technology for storing light water reactor spent fuel. Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (USA)); Bailey, W.J.; Johnson, A.B. Jr.; McKinnon, M.A. *Nuclear Technology (USA)*, 89(2): 141-161 (Feb 1990). DOE Contract AC06-76RL01830.

By 2003, 58 U.S. commercial nuclear power plant units are expected to run out of wet storage space for light water reactor (LWR) spent fuel. This paper reports how, to alleviate this problem, utilities have implemented advanced storage methods that have increased storage capacity as well as reduced the rate of spent-fuel; generation. These methods include transshipping spent-fuel assemblies between pools within the same utility system, reracking pools to accommodate additional spent-fuel assemblies, taking credit for fuel burnup in pool storage rack designs, extending fuel burnup, rod consolidation, and dry storage.

0510 Economic, Industrial, and Business Aspects

46650 (GAO/RCED–90-70BR) **Uranium enrichment: U.S. imports of Soviet enriched uranium.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Jan 1990. 13p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report looks at the following issues: How much Soviet uranium ore and enriched uranium are imported into the United States and what is the extent to which utilities flag swap to disguise these purchases? What are the U.S.S.R.'s enriched uranium trading practices? To what extent are utilities required to return used fuel to the Soviet Union as part of the enriched uranium sales agreement? Why have U.S. utilities ended their contracts to buy enrichment services from DOE?

46651 (INIS-XN–254) **Plutonium fuel an assessment. Report by an expert group.** Nuclear Energy Agency, 75 - Paris (France). 1989. 160p. Order Number DE90640187. Source: NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

Since the 1950s, plutonium used in fast reactors has been seen as the key to unlocking the vast energy resources contained in the world's uranium reserves. However, the slowing down in projected installation rates of nuclear reactors, combined with discovery of additional uranium, have led to a postponement of the point in time when fast reactors will make large demands on plutonium supplies. There are several options concerning its use or storage in the meantime. This report sets out the facts and current views about plutonium and its civil use, both at present and in the medium term. It explains the factors influencing the choice of fuel options and illustrates how economic and logistic assessments of the alternatives can be undertaken.

0520 Waste Management

Refer also to citation(s) 46643, 46648, 46649, 46719, 46910, 47253, 47309, 47310, 47376, 47489, 47550, 47615, 47618, 47619, 47653, 47742, 47783, 47920

46652 (DOE/LLW–74T-Rev.1) **DOE defense waste management needs assessment/resolution document, fiscal year 1988: Revision 1.** EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1988. 270p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. Order Number DE90015996. Source: NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The DOE Office of Defense Waste and Transportation Management (ODWTM) has delegated the responsibility for management

of DOE's radioactive, hazardous chemical, and mixed wastes to the respective field offices where the wastes are generated stored, or disposed. Their responsibility is further assigned to operating contractors. Those operating contractors have designated qualified staff to determine, evaluate, and implement the best technologies, techniques, and operating practices needed and available on cost beneficial bases to assure that all wastes are managed in an environmentally safe and programmatically acceptable manner. This document provides the Ad Hoc Waste Operating Contractors Committee an insight into the operating practices, requirements, and needs of the seventeen contractors operating twenty-five sites under the respective purviews of the eight field offices. Both technical and institutional issues are considered. 4 figs., 1 tab.

46653 (DOE/RL–87-15) **Implementation plan for Hanford site compliance to DOE Order 5820.2, radioactive waste management.** USDOE Richland Operations Office, WA (USA). 1987. 113p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE90017228. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE) issued Order 5820.2, Radioactive Waste Management, on February 6, 1984. The order required that, within 6 months of the date of issuance, the Heads of Field Organizations prepare and submit an implementation plan containing schedules and costs for compliance with the requirements in the order. Thereafter, the status of compliance was to be reported in the annual waste management plan. The first Implementation Plan for Hanford Site Compliance to DOE Order 5820.2, Radioactive Waste Management, was issued in 1984. This document was of sufficient size that the updates in 1985, 1986, and this 1987 edition were issued as companion documents to the annual Hanford Waste Management Plan (HWMP). The development of this implementation plan required a point-by-point review of DOE Order 5820.2 from two perspectives: the compliance status of current waste treatment, storage, and handling practices relative to the requirements of the order, and impacts of compliance with the order on proposed activities and planning for future waste disposal operations. Each of the specific requirements of DOE Order 5820.2 is analyzed in this plan from these perspectives. The two primary contractors having waste management responsibilities at Hanford Site have stated their intention to implement the requirements for current compliance and, where possible, have identified the incremental impacts of the order on present plans for final disposal. 38 refs.

46654 (DOE/WIPP–89-022) **Waste retrieval plan.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. May 1990. 158p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-86AL31950. Order Number DE90013695. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The "Design Criteria Waste Isolation Pilot Plant (WIPP) Revised Mission Concept-IIA, WIPP-DOE-71, Revision 4," requires that underground facilities and equipment be designed to provide for a determination to affect retrieval of all contact-handled (CH) waste stored for a period of up to five years after initial emplacement. The design is also required to account for a period of five to ten years for accomplishing the full retrieval. The Department of Energy (DOE) is committed to retrieve all waste emplaced during the Test Phase if conditions so warrant. This retrieval plan describes the processes, administrative controls and procedures, and organizational responsibilities that will be implemented to ensure protection of human health and the environment during removal of emplaced transuranic (TRU) waste/mixed waste, if the DOE decides that the WIPP facility cannot meet the requirements of 40 Code of Federal Regulations Part 191 and the Resource Conservation and Recovery Act. 27 refs., 10 figs.

46655 (Dounreay-Trans–1030) **Studies of dynamic and static leaching of cemented and uncemented sorption material loaded with Iodine-129.** Furrer, J. (Kernforschungszentrum Karlsruhe Gmbh (Germany, F.R.)). UKAEA Dounreay Nuclear Power Development Establishment (UK). May 1989. 13p. Translated from German. (KFK–4467). Order Number DE90640170. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Translated from German.

Leaching tests with water and brines were conducted on AC 6120 iodine sorption material (12 wt.% Ag) in order to improve the assessment of the behaviour of radioactive waste stored in a repository mine (salt or iron ore). As a result of the dynamic and static leaching tests, the leached fraction of I-129 in the uncemented material was found to be $< 10^{-1}$%, while that of the cemented iodine sorption material was found to be $< 10^{-2}$%. After ordinary steel had been added to the cemented sorption material, the leached fractions found were identical to those measured in uncemented material. The addition of stainless steel had only little influence on the leached fraction. (author).

46656 (EPRI-NP–6947-D) **Technical and economic evaluation of controlled disposal options for very low level radioactive wastes: Final report.** Robinson, P.J. (Robinson (P.J.), Brisbane, CA (USA)); Vance, J.N. Electric Power Research Inst., Palo Alto, CA (USA); Robinson (P.J.), Brisbane, CA (USA); Vance and Associates, Ruidoso, NM (USA). ©Aug 1990. 62p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

Over the past several years, there has been considerable interest by the nuclear industry in the Nuclear Regulatory Commission (NRC) explicitly defined an activity level in plant waste materials at which the radiological impacts would be so low as to be considered Below Regulatory Concern (BRC). In January 1989, Electric Power Research Institute (EPRI) completed an extensive industry research effort to develop the technical bases for establishing criteria for the disposal of very low activity wastes in ordinary disposal facilities. The Nuclear Management and Resources Council (NUMARC), with assistance from the Edison Electric Institute (EEI) and the Electric Power Research Institute (EPRI), drafted a petition titled: "Petition for Rulemaking Regarding Disposal of Below Regulatory Concern Radioactive Wastes from Commercial Nuclear Power Plants." Subsequent to the industry making a final decision for submittal of the drafted BRC petition, EPRI was requested to evaluate the technical and economic impact of six BRC options. These options are: take no action in pursuing a BRC waste exemption, petition the NRC for authorization to disposal of any BRC waste in any ordinary disposal facility, limit disposal of BRC waste to the nuclear power plant site, limit disposal of BRC waste to the nuclear power plant site and other utility owned property, petition for a mixed waste exemption, and petition for single waste stream exemptions in sequence (i.e. soil, followed by sewage sludge, etc.). The petition and technical bases were written to support the disposal of any BRC waste type in any ordinary disposal facility. These documents do not provide all of the technical and economic information needed to completely assessment the BRC options. This report provides the technical and economic basis for a range of options concerning disposal of very low activity wastes. 3 figs., 20 tabs.

46657 (EUR–12017) **Testing of high-level waste forms under repository conditions: Proceedings.** McMenamin, T. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 292p. Sponsored by Commission of the European Communities. (CONF-8810189–: Commission of European Communities workshop on testing of high level waste forms under repository conditions, Cadarache (France), 17-21 Oct 1988). Source: NTIS (US Sales Only), PC A; OSTI; Office for Official Publications of the European Communities 2, rue Mercier L-2985 Luxembourg; Price ECU 22.50.

The Workshop on Testing of High Level Waste Forms Under Repository Conditions was held October 17–21, 1988 in Cadarache, France and sponsored by the Commission of the European Communities (CEC), the Commissariat a l'Energie Atomique (CEA) and the Savanriah River Laboratory (US DOE). Participants included representative from Australia, Belgium, Denmark, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States. The fist part of the conference featured a workshop on in situ testing of simulated nuclear waste forms and proposed package components, with an emphasis on the Materials Interface Interactions Tests (MIIT). MIIT is a 7-part program that involves field testing of 15 glass and waste form systems supplied by seven countries, along with potential canister and overpack materials as well as geologic samples, in the salt geology at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, USA. This effort is still in programs and these proceedings document studies and findings obtained thus far. The second part of the

meeting emphasized multi-national experimental studies and results derived from Repository Systems Simulation Test (RSST), which were performed in granite, clay and salt environments.

46658 (FMPC–2209) **A flexible mode fluidized carbon bed biodenitrification system.** Diggs, I.W. Sr.; Griffin, M.W. Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center. Aug 1990. 71p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-86OR21600. (CONF-9008138–1: 8. international biodeterioration and biodegradation symposium, Windsor (Canada), 26-31 Aug 1990). Order Number DE90016193. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE) began operation of the Feed Materials Production Center (FMPC) near Cincinnati, Ohio in 1951 to produce Uranium metal products for use in various DOE defense programs. The facility was designed to use chemical reduction and metallurgical processes to convert uranium ore concentrates and recycle materials into machined ingots and billets for further processing into finished materials at other DOE installations. Many of the processes were designed to utilize nitric acid for dissolving uranium bearing materials. The resulting raffinate contains high concentrations of nitrates. Waste streams resulting from nitric acid recovery operations and other chemical processes contribute to the volume of process wastewater produced. Many process improvements and modifications have been planned and implemented at the FMPC to reduce nitrate concentrations in the wastewaters generated. Most significant among these has been the development, design and construction of a waste water denitrification facility employing fluidized bed biodenitrification technology. This report summarizes the development and demonstration program efforts which produced the production system process design and provides an overview of the system configuration, major components, and performance characteristics. 9 refs., 13 figs., 3 tabs.

46659 (GAO/RCED–90-1) **Nuclear waste strong issues at DOE's Waste Isolation Plant in New Mexico.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Jan 1990. 56p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This paper addresses the Department of Energy's mined geologic depository - the Waste Isolation Pilot Plant - near Carlsbad, New Mexico, to dispose of nuclear waste produced and stored at defense facilities in 10 states. DOE is seeking legislation that would withdraw the land from public use and allow waste storage to begin. The discovery of saltwater seepage, however, has raised serious questions about the site's suitability as a nuclear waste depository. By storing waste in the plant years before determining compliance with disposal standards that are as yet uncertain, DOE might either have to abandon the plant if it does not comply with the new standard or to remove and/or rehandle wastes in order to comply with the standards. This report recommends that DOE give Congress technical justification for storing waste in the plant before determining if the facility can be used as a repository, contingency plans for disposing of wastes stored in the plant in case DOE finds that the facility does not comply with disposal standards, and options for continued waste storage at other DOE facilities while DOE is finishing its assessment of the plant's compliance with the standards.

46660 (GAO/T-RCED–90-47) **DOE's efforts to correct environmental problems of the nuclear weapons complex.** Rezendes, V.S. General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 14p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report focuses on four main issues: the environmental problems at DOE's nuclear weapons complex, recent changes in DOE's organizational structure, DOE's 1991 budget request, and the need for effective management systems. This report concludes that the environmental problems are enormous and will take decades to resolve. Widespread contamination can be found at many DOE sites, and the full extent of the environmental problems is unknown. DOE has taken several steps during the past year to better deal with these problems, including making organizational improvements and requesting additional funds for environmental restoration and waste management activities.

46661 (IPEN-PUB–169) **NO_x retention in scrubbing column.** Nakazone, A.K.; Costa, R.E.; Lobao, A.S.T.; Matsuda, H.T.; Araujo, B.F. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 10p. (In Portuguese). Order Number DE90640164. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

During the UO_2 dissolution in nitric acid, some different species of NO_x are released. The off gas can either be refluxed to the dissolver or be released and retained on special columns. The final composition of the solution is the main parameter to take in account. A process for nitrous gases retention using scubber columns containing H_2O or diluted HNO_3 is presented. Chemiluminescence measurement was employed to NO_x evalution before and after scrubbing. Gas flow, temperature, residence time are the main parameters considered in this paper. For the dissolution of 100g UO_2 in 8M nitric acid, a 6NL/h O_2 flow was the best condition for the NO/NO_2 oxidation with maximum adsorption in the scrubber columns. (author).

46662 (IPEN-PUB–202) **Statistical considerations on waste packages.** Suarez, A.A.; Rodrigues, D.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Sep 1988. 7p. Order Number DE90640171. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The requirements of the optimization component of the system of dose limitation establishes that planning, designing, using or operating sources and practices at any level of the nuclear fuel cycle or outside of it shall be performed in such a manner that exposures are as low as reasonably achievable, economic and social factor being taken into account. Statistical criteria to guarantee some aspects of the packaging and transport process of the low-and intermediate-level radioactive wastes are proposed and discussed. (author).

46663 (IPEN-PUB–226) **Recovery of valuable products in the raffinate of the uranium and thorium pilot-plant.** Jardim, E.A.; Abrao, A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Nov 1988. 12p. (In Portuguese). Order Number DE90640165. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

IPEN-CNEN/SP has being very active in refining yellowcake to pure ammonium diuranate which is converted to uranium trioxide, uranium dioxide, tetra - and hexafluoride in a sequential way. The technology of the thorium purification and its conversion to nuclear grade products has been a practice since several years as well. For both elements the major to be worked is the raffinate from the solvent extraction colum where and thorium are purified via TBP-varsol in pulsed columns. In this paper the actual processing technology is reviewed with special emphasis on the recovery of valuable products, mainly nitric acid and ammonium nitrate. Distilled nitric acid and the final sulfuric acid as residue are recycle. Ammonium nitrate from the precipitation of uranium diuranate is of good quality, being radioactivity and uranium - free, and recommended to be applied as fertilizer. In conclusion the main effort is to maximize the recycle and reuse of the above mentioned chemicals. (author).

46664 (KFK–4723) **Corrosion testing of selected packaging materials for disposal of high-level waste glass in rock salt formations.** Smailos, E.; Schwarzkopf, W.; Koester, R.; Fiehn, B.; Halm, G. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik. May 1990. 62p. Contract CEC FI 1 W-0032-D. Order Number DE90519889. Source: NTIS (US Sales Only), PC A04/MF A01.

In previous corrosion studies performed in salt brines, unalloyed steels, Ti 99.8-Pd and Hastelloy C4 have proved to be the most promising materials for long-term resistant packagings to be used in heat-generating waste (vitrified HLW, spent fuel) disposal in rock-salt formations. To characterise the corrosion behaviour of these materials in more detail, further in-depth laboratory-scale and in-situ corrosion studies have been performed in the present study. Besides the above-mentioned materials, also some in-situ investigations of the iron-base materials Ni-Resist D2 and D4, cast iron and Si-cast iron have been carried out in order to complete the results available to date. (orig.).

46665 (LBL–25413) **Numerical modeling of gas migration at a proposed repository for low and intermediate level nuclear wastes at Oberbauenstock, Switzerland.** Pruess, K. Lawrence Berkeley Lab., CA (USA). Mar 1990. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90016625. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Hydrologic impacts of corrosive gas release from a hypothetical L/ILW nuclear waste repository at Oberbauenstock are explored by means of numerical simulation. A schematic two dimensional vertical section through the mountain is modeled with the simulator TOUGH, which describes two-phase flow of water and gas in porous and fractured media. Two reference cases are considered which represent the formations as a porous and as a fractured-porous (dual permeability) medium, respectively. Both cases predict similar and rather modest pressure increases, from ambient 10 bars to near 25 bars at the repository level. These results are to be considered preliminary because important parameters affecting two-phase flow, such as relative permeabilities of a fractured medium, are not well known at present. 24 refs., 15 figs., 5 tabs.

46666 (LBL–28819) **Preliminary studies of gas phase flow effects and moisture migration at Yucca Mountain, Nevada.** Tsang, Y.W.; Pruess, K. Lawrence Berkeley Lab., CA (USA). Sep 1989. 42p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90016642. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Yucca Mountain project is investigating the feasibility of siting a repository for high-level nuclear wastes at Yucca Mountain. Part of these investigations include estimates of the release of radionuclides to the accessible environment. Most of the radionuclides of interest will be transported in groundwater but a few radionuclides such as C^{14} could be transmitted through gaseous pathways. An understanding of gas phase flow effects is necessary for determining the quantity of gaseous radionuclides such as C^{14} that could be released at the surface. Gas phase flow has other ramifications besides providing potential pathways for radionuclides to the accessible environment. Through vaporization and condensation processes coupled with vapor transport, gas phase flow effects may indirectly influence the distribution of moisture and liquid phase flow throughout the unsaturated zone. Of paramount importance for an analysis of these coupled gas and liquid flow effects are the boundary conditions at the land surface. One can foresee that a number of factors at the boundary may play a role in affecting the gas movement and liquid infiltration in the mountain. These factors include: gas barometric pressure, temperature, precipitation, wind velocity, relative humidity of the atmospheric air, and topography of the mountain. The purpose of this work is to consider and understand the possible physical processes involving the physical parameters listed above, and to make simple estimates of the magnitude of these processes. We shall focus primarily on barometric pressure and relative humidity effects. 40 refs.

46667 (NAGRA-NTB–89-12) **Wellenberg working programme part 1 for investigations from the surface of the earth and exploratory boreholes SB1, 3 and 4.** Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland). Jul 1989. 166p. (In German). Source: Available from Nagra, CH-5401 Baden, Switzerland.

The first part of the fieldwork planned for Wellenberg is discussed in this work program. This part comprises the investigations conducted from the ground surface and the exploratory boreholes, SB 1,3,4. It belongs to the investigation phase, Wellenberg Ia, which includes further boreholes, an exploratory tunnel to the end of the traverse, as well as a rock laboratory. This report explains goals, methods, extent and sequence of the planned field and laboratory investigations. It serves as a work basis, as well as fulfilling the purpose of informing public agencies, government authorities and the interested public in detail about the planned work. 20 figs., 12 tabs.

46668 (NUREG/CR–5453-Vol.5) **Background information for the development of a low-level waste performance assessment methodology: Computer code implementation and assessment: Volume 5.** Kozak, M.W. (Sandia National Labs., Albuquerque, NM (USA)); Chu, M.S.Y.; McCord, J.T.; Mattingly, P.A.; Johnson, J.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Sandia National Labs., Albuquerque, NM (USA). Aug 1990. 89p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–90-0375-Vol.5).. Source: NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

This report documents the implementation and assessment of computer codes for a low-level waste performance assessment methodology. Computer codes and analytical solutions are implemented for ground-water flow and transport analyses, source-term analyses, surface- water transport analyses, air-transport analyses, food-chain analyses, and dosimetry analyses. The capability has been retained to perform either simple or more complicated analyses of the source term and ground-water transport aspects of the performance assessment. The simple approaches consist of analytical and simple numerical analyses that are appropriate for relatively simple conceptual models. For fully multi-dimensional or transient problems, more complicated numerical solutions are recommended. Details are given of the recommended analytical methods, together with sensitivity analyses that demonstrate important aspects of the solutions. The implementation processes for the more complicated computer codes and those problems that arose during implementation are discussed. Finally, a comparison is given between the simple and complicated ground-water transport analyses for a simple conceptual model. 48 refs., 49 figs., 5 tabs.

46669 (NUREG/CR–5596) **Unsaturated fractured rock characterization methods and data sets at the Apache Leap Tuff Site.** Rasmussen, T.C. (Arizona Univ., Tucson, AZ (USA). Dept. of Hydrology and Water Resources); Evans, D.D.; Sheets, P.J.; Blanford, J.H. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Arizona Univ., Tucson, AZ (USA). Dept. of Hydrology and Water Resources. Aug 1990. 125p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A07/MF A01 - GPO; OSTI; INIS.

Performance assessment of high-level nuclear waste containment feasibility requires representative values of parameters as input, including parameter moments, distributional characteristics, and covariance structures between parameters. To meet this need, characterization methods and data sets for interstitial, hydraulic, pneumatic and thermal parameters for a slightly welded fractured tuff at the Apache Leap Tuff Site situated in central Arizona are reported in this document. The data sets include the influence of matric suction on measured parameters. Spatial variability is investigated by sampling along nine boreholes at regular distances. Laboratory parameter estimates for 105 core segments are provided, as well as field estimates centered on the intervals where the core segments were collected. Measurement uncertainty is estimated by repetitively testing control samples. 31 refs., 10 figs., 21 tabs.

46670 (PNL–4223) **Natural event and human-induced release scenarios for Hanford Defense Waste Draft Environmental Impact Statement.** Wallace, R.W.; Howes, B.W.; Napier, B.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1982. 99p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE90014366. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Natural and human-induced events and scenarios are defined and described that could potentially affect waste containment for the two disposal alternatives and the continued storage (no action) alternative for Hanford Defense Waste (HDW). The events and scenarios described are in part those that have been considered in other studies and some that are introduced from conditions specific to this study. Because some proposed scenarios have not been analyzed, no overall comparison of significance or ranking of importance is made. The primary purpose is to identify potential release mechanisms for the three disposal options, select those believed to be most plausible, and to supply source terms for further analysis of scenarios based on these release mechanisms. Significance of release may not be readily apparent until after a preliminary analysis. The approach used is generally to avoid hypothetical, generic, and worst-case scenarios as much as possible and select those that are believed to be technically plausible and

consistent with current data and knowledge. Four generic scenarios are included for comparative purposes; because they have been analyzed in the literature and because they apply to deep geologic repositories. 79 refs., 3 figs., 17 tabs.

46671 (PNL-SA-17379) **Spent fuel storage requirements for nuclear utilities and OCRWM [Office of Civilian Radioactive Waste Management].** Wood, T.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1990. 11p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. (CONF-900406--73: 1. international topical meeting on high-level radioactive waste management, Las Vegas, NV (USA), 8-12 Apr 1990). Order Number DE90016330. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Projected spent fuel generation at US power reactors exceeds estimated aggregate pool storage capacity by approximately 30,000 metric tons of uranium (MTU). Based on the current repository schedule, little of the spent fuel inventory will be disposed of prior to shutdown of existing reactors, and a large additional capacity for surface storage of spent fuel will be required, either at reactors or at a centralized DOE storage site. Allocation of this storage requirement across the utility-DOE interface, and the resulting implications for reactor sites and the performance of the federal waste management system, were studied during the DOE MRS System Study and again subsequent to the reassessment of the repository schedule. Spent fuel logistics and cost results from these analyses will be used in definition of spent fuel storage capacity requirements for the federal system. 9 refs., 8 figs., 1 tab.

46672 (PNL-SA-17847) **Quality programs for waste management research and development.** Hood, F.C. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9005178--2: 2. annual international seminar on radioactive waste products, Julich (Germany, F.R.), 28 May - 1 jun 1990). Order Number DE90016339. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Pacific Northwest Laboratory (PNL) is a US Department of Energy (DOE) multi-program national laboratory. PNL develops waste management processes and techniques as well as providing management services for characterization and remediation of radioactive and/or hazardous waste sites for the DOE. This paper deals with the application of total quality management principles to waste management research and development activities at PNL. The PNL Quality Program has evolved with expanding expectations for "error-free" performance from the client and the public sector; it describes the management controls needed to achieve desired levels of product quality and to verify they are reached. It includes the definition of work requirements, performance objectives, roles and responsibilities, performance indicators and measurement, performance feedback mechanisms, and process improvement methodologies. 6 refs.

46673 (PNL-SA-18411) **Preliminary fee methodology for recovering GTCC-LLW management costs.** Clark, L.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007106--64: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016424. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The US Department of Energy (DOE) is currently planning a fee to recover costs of managing Greater-Than-Class-C Low-Level Waste (GTCC-LLW). A cash flow basis will be used for fee calculations to ensure recovery of all applicable program costs. Positive cash flows are revenues received from waste generators. Negative cash flows are program expenses for storage, transportation, treatment, and disposal of the wastes and for program development, evaluation, and administration. Program balances are the net result of positive and negative cash flows each year. The methodology calculates fees that will recovery all program expenses taking into account cost inflation. 3 refs., 1 tab.

46674 (PNL-SA-18413) **Treatment alternatives for Greater-Than-Class C low-level waste.** Peters, R.D.; Kurath, D.E. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007106--65: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016537. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Technically and economically viable treatment methods that are amenable to remote operation and that produce waste forms with acceptable properties are needed for treating Greater-Than-Class C low-level waste (GTCC LLW). Processes under consideration are size reduction, incineration, vitrification, cementation, decontamination, and plasma melting. Factors influencing the selection of these technologies, including waste characteristics and waste form disposal criteria are discussed in this paper. The bulk of GTCC LLW is activated and contaminated metals, but other identified materials are combustible trash, cartridge filters, sludges, and ion exchange resins. Methods for treating GTCC LLW are being evaluated to assure that the treated waste form will meet storage and disposal requirements as set forth by regulatory agencies. Appropriate treatment methods can improve waste form quality and save on disposal costs by minimizing volume. Over the next several years, the US Department of Energy, through its National Low-Level waste Management program, plans to perform bench- and pilot-scale tests on various treatment technologies. Radioactive demonstrations will then be conducted where appropriate in preparation for building a treatment facility. The purpose of this paper is to describe the treatment technologies under consideration in this effort. Factors influencing the selection, including waste characteristics and waste form disposal criteria are also discussed. 9 refs., 2 tabs.

46675 (SKB-TR--89-35) **The joint SKI/SKB scenario development project.** Andersson, Johan (ed.) (Swedish Nuclear Power Inspectorate, Stockholm (Sweden)). Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1989. 176p. Order Number DE90637312. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

The Swedish Nuclear Power and Swedish Nuclear Waste Management Co. have carried through a joint scenario development exercise of a hypothetical repository for spent fuel and high level waste based on the KBS-3 concept as disposal method. The starting point has been the 'Sandia methodology', but the actual implementation of the steps in this method has required new strategy development. The work started with a relatively large internationally composed group meeting, which identified an extensive list of features, events and processes (FEPs) that might influence the long term performance of a repository. All these FEPs as well as its possible causes and consequences have been entered into a computer database. The next step was to remove from the list about 30 FEPs of low probability or negligible consequence. In a following step a large number of the FEPs on the original list were assigned to the 'PROCESS SYSTEM', comprising the complete set of 'deterministic' chemical and physical processes that might influence the release from the repository to the biosphere. A scenario is defined by a set of external conditions which will influence the processes in the PROCESS SYSTEM. Approximately 50 FEPs were left representing external conditions. The remaining FEPs could all be combined to form scenarios, but it is concluded that it is not meaningful to discuss combinations without first analysing the consequence and probability of the individual conditions. An important aspect of the work is that the developed strategy includes a framework for the documentation of the complete chain of scenario development. Such a documentation makes possible an extensive review and updating of the set of scenarios. A reviewing process, open to very broad groups in the society, is probably the best means of assuring reasonable completeness and of building up a consensus on what are the critical issues for the safe disposal of radioactive waste.

46676 (SKI--89038) **Study of the flow incoherence introduced when using nested ground-water flow models for the SKI reference site.** Boghammar, A.; Grundfelt, B.; Lindberg, H. Swedish Nuclear Power Inspectorate, Stockholm (Sweden). 4 Oct 1989. 44p. (KEMAKTA-AR--89-06). Order Number DE90640173. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

SKI: Swedish Nuclear Power Inspectorate.

Three new parameter variations have been made in the groundwater flow calculations for the SKI reference site in order to try to deduce the factors influencing the incoherence in flow between the local and the subregional models observed in an earlier study. The local fracture zones were turned off in one variation and in the other the subregional topography was applied to the local model. No major differences could be found between these calculations and the calculation performed with the local base case. In the third variation the same conductivity was used all over the domain. These showed that the major cause for the flow incoherence was the difference in conductivity distribution between the three models. Software has been developed to calculate the flow over the boundary in an inner model in a nested model design, and to compare with the flow over the same boundary calculated with the results obtained from an outer model. The results from the various parameter variations made with the SKI reference site have been submitted to the program and the results confirm the incoherence found in the previous groundwater flow calculations. Software has also been developed to calculate the divergence of the mass-flux in all elements in a model. This is intended to be used as a measurement of the quality of the solution of the ground-water flow calculations. From a numerical point of view, the results from calculating the divergence for the three base case models, are judged to be satisfactorily low but not excellent. (5 refs.).

46677 (UCRL-ID–104197) **Environmental Analytical Sciences: An automation analysis and description of current laboratory procedures.** Stuckemeyer, S.R. Lawrence Livermore National Lab., CA (USA). 7 May 1990. 58p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016675. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Environmental Analytical Sciences (EAS) is a state certified laboratory that analyzes potentially hazardous waste, generated by Lawrence Livermore National Laboratory programs. State laws require that hazardous waste be disposed of within 90 days. Chemistry and Materials Science expects the number of incoming samples to increase rapidly and EAS must be prepared to analyze them in a timely fashion. This report documents an analysis of Environmental Analytical Sciences, which is located in Buildings 222 and 226. It describes pertinent EAS procedures and recommends ways of automating EAS sample preparation, sample analysis, raw data acquisition and test results archiving. 10 figs., 4 tabs.

46678 (UJV–8420-CH) **Selected problems of minimization and management of radioactive wastes from nuclear power plant decommissioning. Part 2.** Kyrs, M.; Moravec, A. Ustav Jadernsho Vyzkumu CSKAE, Rez (Czechoslovakia). Jun 1988. 12p. Order Number DE90638630. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

For Part 1 see report UJV–8410-CH (May 1988).

The processing prior to storage of radioactive wastes produced in nuclear power plant decommissioning is described as are the types of containers employed for waste transport and/or disposal. Data are summarized on exposure of personnel to radioactivity resulting from nuclear power plant decommissioning activities, and accessible data are collected on the costs of nuclear power plant decommissioning and of waste management. Potential directions of research in this field under Czechoslovak conditions are specified. (author).

46679 (WHC-EP–0125-1) **Summary of radioactive solid waste received in the 200 Areas during calendar year 1988.** Anderson, J.D.; McCann, D.C.; Poremba, B.E. Westinghouse Hanford Co., Richland, WA (USA). Apr 1989. 109p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90017211. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Westinghouse Hanford Company manages and operates the Hanford Sites 200 Area radioactive solid waste storage and disposal facilities for the US Department of Energy-Richland Operations Office under contract AC06-87RL10930. These facilities include radioactive solid waste disposal sites and radioactive solid waste storage areas. This document summarizes the amount of radioactive materials that have been buried and stored in the 200 Area radioactive solid waste storage and disposal facilities since startup in 1944 through calendar year 1988. 1 tab.

46680 (WHC-EP–0125-2) **Summary of radioactive solid waste received in the 200 Areas during calendar year 1989.** Anderson, J.D.; McCann, D.C.; Poremba, B.E. Westinghouse Hanford Co., Richland, WA (USA). Apr 1990. 118p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. Order Number DE90017232. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Westinghouse Hanford Company manages and operates the Hanford Site 200 Area radioactive solid waste storage and disposal facilities for the US Department of Energy-Richland Operations Office under contract AC06-87RL10930. These facilities include radioactive solid waste disposal sites and radioactive solid waste storage areas. This document summarizes the amount of radioactive materials that have been buried and stored in the 200 Area radioactive solid waste storage and disposal facilities since startup in 1944 through calendar year 1989. This report does not include solid radioactive wastes in storage or disposal in other facilities or areas such as the underground tank farms. Unless packaged within the scope of WHC-EP-0063, liquid waste data is not included in this document. 1 tab.

46681 (WHC-EP–0182-26) **Tank farm surveillance and waste status summary report for May 1990.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (USA). Aug 1990. 48p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90017231. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive waste stored in the 200 Areas underground tanks at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 56 smaller catch tanks, and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 1 fig., 1 tab.

46682 (WHC-EP–0210) **Waste characterization plan for the Hanford Site single-shell tanks.** Winters, W.I. (Westinghouse Hanford Co., Richland, WA (USA)); Jensen, L.; Sasaki, L.M.; Weiss, R.L.; Keller, J.F.; Schmidt, A.J.; Woodruff, M.G. Westinghouse Hanford Co., Richland, WA (USA). May 1989. 272p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90017236. Source: NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The Waste Characterization Plan for the Hanford Site Single-Shell Tanks (WCP) describes the initial phase of a two-phase plan to characterize the defense wastes stored in single-shell tanks (SST) on the Hanford Site. The WCP represents an all-purpose plan to identify sampling and analysis requirements for regulatory, performance assessment, and technology and process development purposes. Descriptions of SSTs and the wastes are summarized in the WCP. Procedures for sampling and analyzing the waste for chemical, radiochemical, physical, and waste characteristic parameters are described. Rationale for the selection of parameters and for the use of procedures different than standard methods are discussed. Quality assurance and development activities to support this sampling and analysis effort are described in appendices to the WCP. 32 refs., 12 figs., 21 tabs.

46683 (WHC-SA–0880) **Underground storage tank compliance activities at the Hanford Site.** Morton, M.R.; Mihalic, M.A. Westinghouse Hanford Co., Richland, WA (USA). Aug 1990. 15p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. (CONF-9010186–2: HAZTECH international 1990 conference, Pittsburgh, PA (USA), 2 Oct 1990). Order Number DE90017235. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Hanford Site covers 560 mi^2 of semi-arid land that is owned by the US Government and managed by the US Department of Energy-Richland Operations Office (DOE-RL). It is located in the Columbia Basin and northwest of the City of Richland, Washington, which lies approximately 5 mi from the southernmost portion of the Hanford Site boundary and is the nearest population center. In

early 1943, the US Army Corps of Engineers selected the Hanford Site for the production and purification of plutonium. The purpose of this report is fourfold: it describes the underground storage tanks (UST) at the Hanford Site regulated by title 40 Code of Federal Regulations (CFR) 280 (EPA 1988a); it defines the compliance programs completed, underway, or planned by the affected Hanford Site contractors; it provides costs of program compliance; and it defines long-range planning to comply with 40 CFR 280 after 1998. 5 refs., 1 fig., 2 tabs.

46684 (WHC-SA–0937) **Radioactive waste storage tanks at the Hanford Site.** Wodrich, D.D. Westinghouse Hanford Co., Richland, WA (USA). Jun 1990. 21p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. (CONF-9006199–2: United States delegation to the Soviet Union on environmental restoration and waste management conference, Moscow (USSR), 15-29 Jun 1990). Order Number DE90017234. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Hanford Site in south-central Washington State has been a major US Government facility for the production of nuclear materials for nuclear weapons and research and development since the early 1940s. Today, its nuclear material production mission is drawing to a close, and the major mission is waste management and environmental restoration. This paper describes one area of waste management: the storage and disposal of the radioactive waste in underground tanks. Large underground storage tanks have been the central waste management facilities at the Hanford Site. The liquid radioactive wastes resulting from chemically processing nuclear reactor spent fuel to recover the plutonium and uranium have been neutralized and sent to these tanks for the past 46 years. Liquid wastes from other processes, laboratories, and reactor decontamination solutions have also been sent to the tanks. Also, the wastes have been concentrated, selected radioisotopes removed, and the different waste types intermingled. This large volume of multiple waste types, much of it stored in old facilities, presents a challenging waste disposal effort. 18 figs.

46685 (WHC-SA–0982) **An update on the quality assurance for the waste vitrification plants.** Caplinger, W.H. (Westinghouse Hanford Co., Richland, WA (USA)); Shugars, D.L.; Carlson, M.K. Westinghouse Hanford Co., Richland, WA (USA). Sep 1990. 10p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. (CONF-9009153–2: 17. annual conference of the American Society for Quality Control, Tucson, AZ (USA), 9-12 Sep 1990). Order Number DE90017246. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Immobilization of high-level defense production wastes is an important step in environmental restoration. Currently, the best available technology for immobilization of this waste is by incorporation into borosilicate glass, i.e., vitrification. Three US sites are active in the design, construction, or operation of vitrification facilities. The status, facility description, and quality assurance development for each facility was presented at the 1989 Energy Division Conference (ASQC 1989). This paper presents the developments since that time. The West Valley Demonstration Project in northwestern New York State has demonstrated the technology; the Defense Waste Processing Facility at the Savannah River Site in South Carolina as completed design, construction is essentially complete, and preparation for operation is underway; and the Hanford Waste Vitrification Plant in Washington State is in initial Detailed Design. 5 refs.

46686 (WHC-SP–0591-Rev.1) **KE/KW Fuel Encapsulation Task: Management plan: Revision 1.** Lamm, L.W. Westinghouse Hanford Co., Richland, WA (USA). Jul 1990. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90017245. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The KE/KW Fuel Encapsulation Task is one of two tasks comprising the KE/KW Operations Standardization and Water System Upgrades Program defined in the program plan. The purpose of this plan is to define the subject task and state how it will be managed. The plan includes: a definition of the tasks objectives and scope; a review of the task background; a description of the activities required to accomplish the task objectives; a description of the organization, projected cost and schedule, controls, reporting and records required to accomplish the task; a discussion of the potential risks associated with performing the task; and identification of the quality assurance, environmental and safety controls to be applied to the task. The task will consist of two phases. Phase I includes the performance of several tasks required to be completed prior to the start of the fuel encapsulation, including: general KE basin upgrades; design, procurement, fabrication, installation and verification of the KE/KW encapsulation assemblies; start of the procurement of additional canisters; preparation of the KE/KW facilities' hazardous classification letter (HCL), criticality safety evaluation report (CSER), safety analysis report (SAR), operational safety requirements (OSR) and environmental documentation; preparing/revising Process Standards documentation as needed; decontamination of the KE basin; preparation of ALARA plans; performance of SAR and OSR reviews by the Safety and Environmental Advisory Council (SEAC); and performance of start-up reviews by the Readiness Review Board (RRB). Phase II includes encapsulation of the fuel stored in 3659 open canisters in the KE basin, re-encapsulation of the fuel stored in 1806 MK I canisters in the KW basin, and preparation of the open and MK I canisters for disposal.

46687 (WSRC-RD–90-10) **A sample compositing strategy for classifying non-radioactive hazardous waste for transport.** Winn, W.G. Westinghouse Savannah River Co., Aiken, SC (USA). Jun 1990. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE90016674. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A probabilistic strategy for sample compositing is developed to minimize the radiometric analyses required for classifying non-radioactive waste for transport. Such waste must have concentrations of total radioactivity that are below an acceptance limit of L = 2 nCi/g. A composite of N different samples must have a radioactive concentration below L/N to assure that no individual sample is unacceptable. Unacceptable samples are eventually identified by analyses of successive splits composited with N/2, N/4, ··· of the original samples. The probable number of such analyses is derived using Gaussian distributions for the composite concentrations, per invoking the Central Limit Theorem. A preliminary compositing strategy, based only on the average concentration μ, uses $N = L/\mu$ to yield a minimum fraction of $\approx 2\mu/L$ analyses per total samples. These approximations are useful for $L/\mu > 4$. Refined strategies, based on both the μ and σ for the concentration distribution, define the optimization more precisely. Experimental data from composites of 880 samples of low-level radiometric waste are consistent with the calculated predictions. 11 refs., 4 figs., 1 tab.

46688 **The changing role of the quality professional.** Thompson, R.G. (EG and G Idaho, Inc., Idaho Falls, ID (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the historic role of the quality professionals in a Department of Energy Idaho Operations Office (DOE-ID) contractor's organization. The quality professional's changing role is presented.

46689 **Hanford's quality training resource center: Instrument for cultural change.** Saget, P. (US Dept. of Energy, Richland Operations Office, Richland, WA (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the objectives of a quality training resource center (QTRC). The author describes the scope and process and schedule for implementation. A synopsis of the QTRC is presented.

46690 **Quality assurance requirements for high-level waste form production.** Chacey, K. (US Dept. of Energy, Office of Defense Waste and Transportation Management (US)). pp. 1-1 of International waste management conference. American Society for

Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the quality assurance requirements for high-level canistered waste form products which would be acceptable for disposal in a deep geologic repository. A review plan and guidelines are provided.

46691 The high-level waste quality assurance program for the West Valley Demonstration Project. Bixby, W.W. (US Dept. of Energy, West Valley Project Office, West Valley, NY (US)); Maestas, E.; Thomas, R.A. pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the solidification of high-level liquid waste remaining from nuclear fuel reprocessing activities. Focus is on the approach taken to ensure integration of quality assurance requirements.

46692 Implications for HLW quality assurance from reactor licensing litigation. Cameron, F.X. (US Nuclear Regulatory Commission, Office of the General Counsel (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the difficulties encountered in obtaining licensing by several nuclear power plants due to their inability to document and implement an adequate assurance program. The author reports on possible improvements in the quality assurance in design and construction. Power reactor licensing cases are reviewed.

46693 Quality assurance as an evidentiary tool in NRC administrative proceedings to obtain a construction authorization. Echols, F.S. (US Dept. of Energy, Office of General Counsel (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the evolution of a current QA program at Yucca Mountain. The value of this program as an evidentiary tool is presented.

46694 How quality results were achieved during construction and testing in Atomic Energy of Canada's underground research laboratory. Baker, J.C. (US Dept. of Energy, Chicago Operations Office, Chicago, IL (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the extension and geotechnical characterization and testing within a 443-meter deep shaft in eastern Manitoba's Canadian Shield. Although no formal, United States-approved Quality Assurance (QA) was implemented during the construction, characterization and testing, quality results were obtained. The author describes a disciplined management system developed to control the project. This paper cites how certain quality results were obtained through the use of appropriate procedures.

46695 QA - A line manager's perspective. Hood, F.C. (Battelle Pacific Northwest Lab., Richland, WA (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the need of the QA program to keep pace to ensure proper coverage and to support achievement of programmatic objectives. Needed measures are described and commented upon by the author.

46696 Quality assurance of waste acceptance process activities: A doer's view. Plodinec, M.J. (E.I. DuPont de Nemours and Co., Savannah River Lab., Aiken, SC (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the construction of a facility to immobilize high-level nuclear waste. Application of the quality assurance process to production of canistered wasteforms is described.

46697 Value added by the QA program. Mellinger, G.B. (Battelle Pacific Northwest Lab., Richland, WA (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper describes how the QA program at Pacific Northwest Laboratory has been implemented on two projects. The author discusses how the QA program has been helpful, and some pitfalls are offered.

46698 Leading the spirit of quality. Claudson, T.T. (Battelle Pacific Northwest, Richland, WA (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the history of quality programs. The components of quality are described. The author reports on the responsibilities for setting standards that must be accepted by management.

46699 Quality assurance in the high-level waste program: A management perspective. Kale, S.H. (US Dept. of Energy, Office of Civilian Radioactive Waste Management (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the significant management challenge involved in the application of quality assurance requirement and controls. The author reports on the relationship between the basic sciences and the quality assurance approach.

46700 Interpreting quality assurance requirements from a project management perspective. Dronkers, J.J. (Lawrence Livermore National Lab., Livermore, CA (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the comparison of the policy requirements with the implementing procedures of a quality assurance program. The author illustrates fundamental differences between policy and practices and how one research institution has come to grips with what once were considered excessive requirements.

46701 Status of the Yucca Mountain Project. Gertz, C.P. (US Dept. of Energy, Yucca Mountain Project Office (US)). pp. 1-2 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper presents an overview of the Yucca Mountain Project, its accomplishments, current activities, and upcoming challenges. Focus is on site characterization, the current phase of the repository program. The author discusses project schedule, Site Characterization Plan and study plans, exploratory shaft facility site preparation and construction, and surface-based testing and drilling. Topical areas addressed include geology, hydrology and geochemistry.

46702 Quality assurance in the OCRWM program. Barrett, L.H. (US Dept. of Energy, Office of Civilian Radioactive Waste Management (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper provides a status on efforts underway to effect and implement the OCRWM Quality Assurance Program in Headquarters and at the Yucca Mountain Project. The author reports that given the magnitude, complexity, and longevity of the program, emphasis on quality - doing the job right the first time - contributes to cost-effectiveness and assurance that component systems perform needed functions reliably and efficiently.

46703 Quality assurance overview: UMTRA project. Matthews, M.L. (US Dept. of Energy, Albuquerque Operations Office, NM (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the development and implementation of the quality assurance program at twenty four sites. The author describes the quality assurance procedures involved in the site investigations and characterization activities, as well as the quality control and quality assurance associated with the engineering, design construction, and inspection services necessary to accomplish cleanup and permanent stabilization at the sites.

46704 Quality assurance program for a high-level waste repository from a manager's perspective. Hunter, T.O. (Sandia National Laboratories, Albuquerque, NM (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper summarizes the basic characteristics of classic QA programs. The author relates these characteristics to the key aspects of a nuclear waste repository program.

46705 Quality assurance program covering mixed waste disposal at the Nevada test site. O'Neill, L.J. (US Dept. of Energy, Nevada Operations Office, NV (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses a quality assurance program that would satisfy the requirements and expectations of the U.S. Department of Energy, the EPA, and the state of Nevada. The author outlines the basic philosophy, concepts, and implementation of the program that would satisfy all three agencies.

46706 Quality assurance program covering low-level radioactive waste disposal at the Nevada test site. Fitzsimmons, P.K. (US Dept. of Energy, Nevada Operations Office, NV (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper reviews the basic services that the low-level radioactive waste facility provides and the areas that are considered important to the success of the operation. The quality assurance requirements necessary to assure the degree of excellence in this area is discussed.

46707 Quality assurance requirements for an institution with diverse technical activities at the Nevada test site (NTS). Kunich, M.P. (US Dept. of Energy, Nevada Operations Office, NV (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, Wi (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

The author describes the Nevada test site's restructuring of its approach to quality assurance. Basic requirements are being expanded and augmented. The nature of the quality assurance program is discussed.

46708 Quality assurance: Views of two different people – project manager vs. quality assurance director. Kunich, M.P. (US Dept. of Energy, Nevada Operations Office, NV (US)); Vieth, D.L. pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper provides a point/counterpoint view of a quality assurance director and a project manager. It presents numerous aspects of quality assurance requirements along with analyses as to the value of each.

46709 Quality assurance on the Idaho National Engineering Laboratory Buried Waste Program. Rasmussen, T.L. (EG and G Idaho, Inc., Idaho Falls, ID (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the clean-up of an Idaho National Engineering Laboratory (INEL) site utilized for disposal of transuranic contaminated waste from 1954 until 1970. The author presents requirements of the environmental protection statutes that have generated quality assurance requirements in addition to those historically implemented as a part of facility design, construction and operation. A hierarchy of program guidance quality documentation and procedures is discussed. Data qualification and computer database management are identified as requirements.

46710 Implementation of environmental QA practices at a mixed waste site at the Idaho National Engineering Laboratory. Bonzon, C.J. (EG and G Idaho, Inc., Idaho Falls, ID (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the Buried Waste Program (BWP) at the Idaho National Engineering Laboratory (INEL) established to determine sources, characterize the extent of contamination, and mitigate further migration of radioactive and hazardous waste from the buried waste at the Radioactive Waste Management Complex (RWMC) at the INEL. The author describes understanding the purpose of detailed field sampling QA procedures for environmental clean-ups that must be followed at a DOE facility, and how the BWP implements these procedures during site characterization at the RWMC.

46711 Has quality assurance outlived its usefulness. Goldenberg, N. (US Dept. of Energy, Quality Verification Div. (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper explores the impact that better management and increased productivity will have on the need for, and role of, quality assurance in the future. The author discusses criticisms of existing quality assurance programs.

46712 Of course it can be done. Little, L.E. (US Dept. of Energy, Grand Junction Project Office, Grand Junction, CO (US)). pp. 1-2 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the Department of Energy Grand Junction Projects Office and its development of a QA program. The author explains the GJPO QA Program structure and shows how a QA program based on NQA-1 can readily and effectively be used on all types of environmental and geotechnical work, including EPA projects. Emphasis is on the benefits of achieving work quality, including cost effectiveness, maintaining schedules and customer satisfaction.

46713 Management control system for the Hanford Environmental Restoration Remedial Actions Program. Freeburg, R.D. (US Dept. of Energy, Richland Operations Office, Richland, WA (US)); Jordan, K.J. pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the environmental legislation enacted to guide environmental restoration of the Hanford site. The key elements of the program are reported.

46714 Application of quality assurance to waste management and environmental activities at Hanford. Saget, P. (US Dept. of Energy, Richland Operations Office, Richland, WA (US)); Nicoll, B.L.; Gerton, R.W.; Freeberg, R. pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper reports on the enhanced management commitment to quality and safety on those operations which are primarily waste management with emphasis on environmental restoration. The authors focus on restoration activities and these are presented.

46715 Role of quality assurance vs project manager's responsibility for waste projects. Solecki, J. (US Dept. of Energy, Idaho Operations Office, ID (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487–: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper takes a project manager's perspective and discusses the role of the quality assurance organization in the development, implementation and interface related to the QA program for waste projects. The author describes the role which the QA program plays in allowing project management to assure that the project manager knows what is placed in the repository and the characteristics of the surrounding environment meet closure requirements.

46716 U.S. high-level waste disposal. Rousso, S. (Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, DC (US)). *Proceedings of the American Power Conference (USA)*, 51: 27-30 (1989). (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper discusses the isolation of spent fuel and high level radioactive waste from the accessible human environment. The author presents a review of the legislation that guides U.S. high level waste activities. Current review policies are outlined.

0530 Environmental Aspects

Refer also to citation(s) 46655, 46660, 46701, 46702, 46709, 46710, 46712, 46713, 46714, 46715, 46716, 46874, 47489, 47619

0540 Health and Safety

Refer also to citation(s) 46640, 46647, 46729, 47472, 47490, 47927

46717 (CDTN-DERL-PD–007/84) **Analysis of the radiological protection report from CIPC regarding to 1983 year.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 10 Jul 1984. 19p. (In Portuguese). Order Number DE90639752. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

To identify activities, operations or periods more critical, in order to offer subsidies that permit adoption of preventive action within limits of operational radiation is the objective of this analysis. (author).

46718 (DOE/EH–0159T) **Effectiveness of sheltering in buildings and vehicles for plutonium.** Engelmann, R.J. Pacific Northwest Lab., Richland, WA (USA). 30 Jul 1990. 48p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE90016697. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The purpose of this paper is to collect and present current knowledge relevant to the protection offered by sheltering against exposure to plutonium particles released to the atmosphere during accidents. For those many contaminants for which effects are linear with the airborne concentration, it is convenient to define a Dose Reduction Factor (DRF). In the past, the DRF has been defined as the ratio of the radiological dose that may be incurred within the shelter to that in the outdoors. As such, it includes the dose through shine from plumes aloft and from material deposited on the surface. For this paper, which is concerned only with the inhalation pathway, the DRF is the ratio of the time-integrated concentration inside the shelter to that outdoors. It is important to note that the range over which effects are linear with concentration may be limited for many contaminants. Examples are when concentrations produce effects that are irreversible, or when concentrations are below effects threshold levels. 71 refs., 4 figs., 8 tabs.

46719 (DOE/RL–90-35) **Hanford federal facility agreement and consent order: Quarterly progress report for the period ending June 30, 1990.** USDOE Richland Operations Office, WA (USA). Aug 1990. 62p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90017268. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This is the fifth quarterly report as required by the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989), also known as the Tri-Party Agreement, established between the US Department of Energy, the US Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology). The Tri-Party Agreement sets the plan and schedule for achieving regulatory compliance and cleanup of waste sites at the Hanford Site. This report covers progress for the quarter that ended June 30, 1990. 27 refs., 2 figs.

46720 (PNL-SA–17757) **Long-term follow-up of HAN-1, an acute plutonium oxide inhalation case.** Carbaugh, E.H.; Bihl, D.E.; Sula, M.J. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900733–2: 3. international workshop on respiratory tract dosimetry, Albuquerque, NM (USA), 1-3 Jul 1990). Order Number DE90017194. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The International Commission on Radiation Protection (ICRP) has recommended that plutonium oxide be designated an inhalation class Y material, indicating that a 500-day clearance half-time from the lung is adequate for radiation protection purposes. Based on extensive data obtained from one particular inhalation case (referred to here as HAN-1), and supported by somewhat less detailed data in nine other cases, an argument has been put forth that substantially longer clearance half-times may not be uncommon for Pu oxide. This has led to the tentative identification of a "super class Y" form of Pu which has been factored into worker monitoring programs at the US Department of Energy's Hanford Site. In addition, the United States Transuranium Registry autopsy work has indicted evidence to support the super class Y case. The particular case described in this paper was the key case which caused the Hanford internal dosimetry staff to seriously consider super class Y material. This paper includes data from long-term follow up monitoring as well as early data for calculating intakes for comparisons with secondary limits. 13 refs, 2 figs., 1 tab.

46721 (PNL-SA–18138) **Multimedia approach to estimating target cleanup levels for soils at hazardous waste sites.** Hwang, S.T. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900676–13: 83. annual meeting and exhibition of the Air and Waste Management Association, Pittsburgh, PA (USA), 24-29 Jun 1990). Order Number DE90016563. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Contaminated soils at hazardous and nuclear waste sites pose a potential threat to human health via transport through environmental media and subsequent human intake. To minimize health risks, it is necessary to identify those risks and ensure that appropriate actions are taken to protect public health. The regulatory process may typically include identification of target cleanup levels and evaluation of the effectiveness of remedial alternatives and the corresponding reduction in risks at a site. The US Environmental Protection Agency (EPA) recommends that exposure assessments be combined with toxicity information to quantify the health risk posed by a specific site. This recommendation then forms the basis for establishing target cleanup levels. An exposure assessment must first identify the chemical concentration in a specific medium (soil, water, air, or food), estimate the exposure potential based on human intake from that media, and then combined with health criteria to estimate the upperbound health risks for noncarcinogens and carcinogens. Estimation of target cleanup levels involves the use of these same principles but can occur in reverse order. The procedure starts from establishing a permissible health effect level and ends with an estimated target cleanup level through an exposure assessment process. 17 refs.

46722 (WHC-SA–0875) **Training plans and programs: Performance or promises?.** Johnson, B.J.T. Westinghouse Hanford Co., Richland, WA (USA). Jul 1990. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-9007106–68: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90017266. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE)/Office of Safeguards and Security Training Advisory Committee and DOE ORDER 5633.3 are generating interest within the Material Control and Accountability (MC&A) community to examine current and future MC&A training needs. Producing a consistent training standard should be a common concern for those responsible to provide training. The Westinghouse Hanford Company Safeguards Training Plan provides a formally documented custodian training program that specifies the audience, pre- determined objectives, and purposeful learning activities based on realistic training needs assessment, such as on-the-job training. It also includes a thorough record of participation and results for internal and external audit and inspection purposes. Custodian training designed to convey basic MC&A concepts and philosophy broadens understanding and improves performance of those providing the first line of defense against insider threats. Custodian performance is often the key factor used to evaluate the effectiveness of the overall MC&A system. Adequate resources must be applied by management to develop and provide a training program standard that reflects the importance of MC&A responsibilities within the DOE complex.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 46722, 46729

46723 (BNL–44962) **Evaluation of detection elements for the implementation of the performance requirements of DOE Order 5633.3 (Materials Control and Accountability).** Kane, W.R. (Brookhaven National Lab., Upton, NY (USA)); Magurno, B.A.; Rivers, J.D. Brookhaven National Lab., Upton, NY (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-9007106–60: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016312. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The performance requirements of DOE Order 5633.3 (Materials Control and Accountability) specify that facilities which have custody of special nuclear material (SNM) should demonstrate that their protective systems achieve a designated level of performance in detecting the theft or diversion of SNM. The performance levels are defined in terms of a detection probability, a goal quantity of material, and a time to detection, depending upon the category and attractiveness of the material. In a typical facility there are approximately 25 individual elements of the system which contribute detection capability; the methods of vulnerability assessment are employed to combine the detection probabilities of those elements which enter into a given removal scenario to obtain an overall detection probability for the scenario. The central problem in this process is the quantitative determination of a valid detection probability for each element of the system for all relevant conditions. This requires the thorough evaluation of both the physical and procedural attributes of each element. In addition, strategies available to the adversary for the defeat of a given element must be considered. The combined metal detector – SNM portal monitor element is discussed as an example of the evaluation process. 7 refs., 1 fig.

46724 (NUREG–0525-Rev.16) **Safeguards Summary Event List (SSEL), pre-NRC through December 31, 1989: Revision 16.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards and Transportation. Jul 1990. 365p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A16/MF A01 - GPO; OSTI; INIS.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Because of public interest, the Miscellaneous category includes a few events which involve either source material, byproduct material, or natural uranium which are exempt from safeguards requirements. Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, tampering/vandalism, arson, firearms, radiological sabotage, nonradiological sabotage, alcohol and drugs (involving reactor operators, security force members, or management persons), and miscellaneous. The information contained in the event descriptions is derived primarily from official NRC reporting channels.

46725 (PNL-SA–18037) **OSE material control and accountability inspection results.** Coady, K.J. (USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Office of Security Evaluations); Byers, K.R.; Smith, B.W. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. (CONF-9007106–59: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016294. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy Office of Security Evaluations (DOE-OSE) conducts independent inspections of DOE facilities using system performance test and performs topical assessments and program evaluations. One purpose of these activities is to assess the effectiveness of DOE's implementation of nuclear material control and accountability (MC&A) policies, procedures, systems and operations. This paper provides an analysis of MC&A inspection results and ratings compiled from 16 OSE inspections conducted during the period from November 1986 to January 1990. A discussion postulates why some deficiencies are frequently identified. 7 refs., 1 fig.

46726 (UCRL-JC–104453) **Evaluating safeguard effectiveness against violent insiders.** Al-Ayat, R.A.; Fortney, D.S. Lawrence Livermore National Lab., CA (USA). 16 Jul 1990. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9007106–63: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016469. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The threat posed by a violent insiders presents a major challenge to safeguards managers. These insiders, in addition to their ability to exploit their special authorities, access, and knowledge of facility operations and safeguards, could use violence to defeat safeguards components and personnel. In protecting against theft of special nuclear material, facilities have emphasized the use of perimeter protection and physical barriers to protect against attacks by an outsider adversary group. Recently emphasis has begun to shift toward the implementation of hardware and procedural measures to protect against nonviolent insiders. Approaches are also needed to help assess the effectiveness of protection against those insiders who are willing to use violence. In this paper we describe an approach we're developing for dealing with violent insiders. We begin by categorizing insiders according to whether they are active or passive, rational or irrational, and whether they are willing to use force against safeguards components or coworkers. We define characteristics of each category, and describe the extent to which each category is adequately modelled by existing evaluation tools. We also discuss several modelling issues posed by active insiders, including: entry of contraband; reluctance to use violence; neutralization of insiders; and the ability to switch modes of attack between force, stealth, and deceit. 5 refs., 2 figs.

46727 (UCRL-JC–104488) **A model of adversary characteristics for designing employee monitoring programs.** Lamont, A.; Smith, G. Lawrence Livermore National Lab., CA (USA). 16 Jul 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9007106–62: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90016471. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Employee screening and monitoring programs are an important component of the defense in depth at nuclear facilities. Ideally, such programs should maximize the probability of detecting an adversary and minimize the probability of falsely "detecting" a nonadversary by taking into account the characteristics of potential

adversaries. This paper presents a model for identifying patterns of characteristics, or indicators, that may be more prevalent among adversaries than among non-adversaries and, therefore, can be used for detecting adversaries. It assumes that adversaries are detected when a background check or other monitoring program recognizes suspect patterns of indicators such as drug abuse, unexplained income, financial problems, abnormal scores on psychological tests, etc. The model quantifies the probabilities that adversaries will manifest various patterns of indicators. The analyses presented in the paper identify sets of patterns that are most likely to be manifested by several types of adversaries. Monitoring programs that can recognize these patterns should be more likely to detect adversaries. We have also estimated the probability that a normal employee might manifest the same patterns and be incorrectly detected as an adversary. The likelihoods use subjective probability judgements, however, statistical measures can be incorporated should they become available. 5 refs., 3 figs., 2 tabs.

46728 (WHC-SA–0853) **Using vulnerability assessments to define upgrade actions.** Udell, C.J.; Billings, M.P.; Layman, B.J.; Schultheiss, R.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-9007106–69: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90017241. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Determining appropriate and cost-effective upgrades for safeguards and security (S&S) systems is demanding activity. The process requires that specific weaknesses be recognized through a vulnerability assessment (VA), candidate upgrades be identified, through analysis of VA results in conjunction with other significant influences, and various upgrade options be evaluated, prioritized, and selected. The goal is to select upgrades that reduce risk to an acceptable level for the lowest cost while minimizing any negative impacts on productivity, safety, environment, etc. 1 fig., 2 tabs.

0560 Legislation and Regulations

Refer also to citation(s) 46649, 46653, 46716, 46853

46729 (NUREG–1272-Vol.4-No.2) **Office for Analysis and Evaluation of Operational Data: 1989 annual report, Nonreactors.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data. Jul 1990. 66p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

The annual report of the US Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) is devoted to the activities performed during 1989. The report covers nonreactors and presents a review of the events and concerns during 1989 associated with the use of licensed material in nonreactor applications, such as personnel overexposures and medical misadministrations. This volume contains a list of the AEOD reports issued for 1980–1989. 5 tabs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

46730 (CDTN-DERL-PD–009/81) **Liquid discharge and velocity measurings of flow in Sa Carvalho Hydroelectric Power Plants (ACESITA).** Moreira, R.M.; Aun, P.E.; Minardi, P.S.P.; Bomtempo, V.L.; Castro, J.O.N.M. de; Silva Gomes, R. da; Fioravante Neto, A.; Souza Vieira, N. de; Costa, D.A. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Mar 1981. 29p. (In Portuguese). Order Number DE90639888. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Liquid discharge and velocity measurings of flow in Sa Carvalho Steel Mill, ACESITA, using radioactive tracers by velocity and total count methods are described. (C.M.).

46731 (CDTN-DERL-PD–028/84) **Study of underwater emissary construction to the liquid and solid effluentes from ICC in Imbituba - SC.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Nov 1984. 300p. (In Portuguese). Order Number DE90639889. Source: NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Studies accomplished by CDTN aiming to construct an undewater emissary to discharge liquid wastes and gypsum from Industria Carboquimica Catarinense S/A, in Imbituba - SC are described. (author).

46732 (INT–207/I) **Radioisotopic methods in the aerospace technology.** Lewitowicz, J. (Instytut Techniczny Wojsk Lotniczych, Warsaw (Poland)). Institute of Physics and Nuclear Techniques, Cracow (Poland). 1986. 34p. (In Polish). Order Number DE90639891. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Various applications of the radioisotopic methods in aerospace technology are presented. New examples of such applications refer to: the radioisotopic investigations of using up processes in aircraft engines; the new designs of airplain instruments; the investigation of aerospace materials by use of non-destructive methods. 22 refs., 17 figs. (author).

0705 Health and Safety

Refer also to citation(s) 46729, 47927

08 HYDROGEN

0801 Production

Refer also to citation(s) 46959

46733 (DOE/MC/10637–2803 Paper 13, 18) **Production of hydrogen from low-rank coals.** Sears, R.E. (Univ. of North Dakota, Grand Forks (USA)); Timpe, R.C. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988–December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The objective of this research is to evaluate the technical feasibility of producing low-cost hydrogen by catalytic steam gasification of low-rank coals. This approach takes advantage of the high reactivity, volatile matter, moisture concentration, and inherent alkali content of low-rank coals. Bench-scale investigations of low-rank coal steam gasification have already shown product gas compositions and reaction kinetics favorable to hydrogen production. This effort will provide a proof-of-concept and the early stages of engineering development. In parallel with this process development and systems analysis work, an evaluation of the relationship between the fundamental properties of low-rank coals and their reactivity under hydrogen-producing conditions will be conducted.

0802 Storage, Transport, and Handling

46734 (CEA-CONF–10119) **Perturbed angular correlation study of hydrogen diffusion in hydrides of crystalline and amorphous Zr_2Ni.** Chikdene, A.; Baudry, A.; Boyer, P. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale. 1988. 8p. (CONF-880969–9: International symposium on metal-hydrogen systems, fundamentals and applications, Stuttgart (Germany, F.R.), 4-9 Sep 1988). Order Number DE90518441. Source: NTIS (US Sales Only), PC A02/MF A01.

Perturbed Angular Correlation (PAC) measurements were performed on crystallized hydrides Zr_2NiH_x as well as on amorphous $Zr_2NiH_{2.5}$. The temperature dependence of the spin relaxation constant in the different hydrides is discussed. The PAC results obtained in the amorphous hydride confirm the observation made in other systems that the diffusion of interstitial hydrogen is easier in amorphous than in crystalline lattices. However, our data do not indicate the existence of a broad distribution of activation energies for hydrogen jumps.

46735 (CEA-CONF–10120) **Neutron diffraction studies of $Zr_2NiH(D)_x$ hydrides.** Chikdene, A.; Baudry, A.; Boyer, P. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale. 1988. 7p. (CONF-880969–8: International symposium on metal-hydrogen systems, fundamentals and applications, Stuttgart (Germany, F.R.), 4-9 Sep 1988). Order Number DE90518443. Source: NTIS (US Sales Only), PC A02/MF A01.

Powder neutron diffraction studies have been performed on the Zr_2Ni-D system at room temperature and at 420K. A tetragonal to orthorhombic structural phase transition has been observed in going from 420K to room temperature for the highly charged $Zr_2NiD_{4.8}$ deuteride. The sites occupation varies with composition and we give it for three formulas. Various factors to be considered in the filling scheme of this system are discussed.

46736 (CEA-CONF–10124) **Phase separation in amorphous CuTi hydrides.** Rodmacq, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR). Dept. de Recherche Fondamentale); Billard, L.; Chamberod, A.; Maret, M. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale. 1988. 7p. (CONF-880969–11: International symposium on metal-hydrogen systems, fundamentals and applications, Stuttgart (Germany, F.R.), 4-9 Sep 1988). Order Number DE90518439. Source: NTIS (US Sales Only), PC A02/MF A01.

Neutron diffraction experiments have been performed on amorphous $Cu_{0.5}$ $Ti_{0.5}$ hydrides in order to study the influence of hydrogen on the structure of the amorphous CuTi matrix. The comparison of the neutron pair correlation functions before and after hydrogen loading shows that the contribution of the Cu-Ti pairs is much smaller than the Cu-Cu and Ti-Ti ones after hydrogen loading. This indicates that phase separation takes place in these amorphous alloys upon hydrogen absorption, as confirmed by the appearance of a small-angle maximum in the interference function. These results are used to construct a model for the amorphous matrix before and after hydrogen loading, and a good agreement is obtained between experimental and simulation results for both the structure of the matrix and the location of hydrogen.

46737 (CEA-CONF–10125) **Structural relaxation and hydrogen absorption in amorphous FeTi alloys.** Chambron, W.; Rodmacq, B.; Chamberod, A. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale. 1988. 7p. (CONF-880969–10: International symposium on metal-hydrogen systems, fundamentals and applications, Stuttgart (Germany, F.R.), 4-9 Sep 1988). Order Number DE90518440. Source: NTIS (US Sales Only), PC A02/MF A01.

The variation of the Curie temperature of an amorphous Fe_{73} Ti_{27} alloy has been studied as a function of both relaxation state and hydrogen content. For hydrogen-free samples T_c first decreases and then increases with increasing annealing temperature, corresponding to structural relaxation and onset of crystallization respectively. In structurally-relaxed hydrogenated samples, it appears that the hydrogen absorption capacity strongly depends on the surface state of the sample. This surface state (and thus the kinetics of hydrogen absorption) can be modified by a heat treatment under hydrogen atmosphere.

46738 (KCP–613-4204) **Organic getter materials for the removal of hydrogen and its isotopes.** Smith, H.M.; Shepodd, T.J.; Gilliom, L.R. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Aug 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. (CONF-8909204–6: 4. international conference on hydrogen effects on material behavior, Jackson Hole, WY (USA), 12-16 Sep 1989). Order Number DE90016284. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Herein, we describe hydrogen getter technologies developed at SNL and KCD over the past decade. The technologies are based on the irreversible removal of hydrogen by catalytic hydrogenation of unsaturated organic compounds. Different types have been developed: crystalline getters, dialkynes combined with heterogeneous catalysts; and a polymeric getter, a thermoplastic elastomer capable of reacting with hydrogen in the presence of oxygen without producing water. These materials can remove up to 300 cc (STP) of hydrogen per gram of material, and can maintain atmospheres of less than 10 ppM hydrogen. Crystalline getters for tritium and the combination hydrogen(tritium), water, and oxygen are described. The accumulation of hydrogen is usually an undesired event. Large leaks from hydrogen storage and handling facilities pose explosion hazards. Small amounts of hydrogen that may build up in sealed containers after long storage times can damage integral components. Any tritium leak is an immediate health hazard. Hydrogen scavengers or getters can avert all of these potential problems by irreversibly removing hydrogen from such environments. In this paper, we describe the development of two types of organic getters: the first is a new crystalline getter, based on 1,4-bis(phenylethynyl)benzene[5] (DEB); the second is a polymeric hydrogen getter, based on styrene-butadiene copolymer.

0805 Health and Safety

Refer also to citation(s) 46738

0830 Combustion

46739 **Simultaneous measurement of mixture fraction and hydroxyl radical concentration in a lifted hydrogen flame.** Barlow, R.S. (Combustion Research Facility, Sandia National Lab., Livermore, CA (US)); Dibble, R.W.; Fourguette, D.C. pp. 207-212 of 1989 Spring technical meeting on combustion fundamentals and applications. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-890446–: Combustion Institute spring meeting: combustion fundamentals and applications, Dearborn, MI (USA), 30 Apr - 2 may 1989).

This paper discusses techniques of Raman scattering and laser-induced fluorescence (LIF) that have been combined to perform simultaneous point measurements of major species concentrations, temperature, and hydroxyl radical concentration in a lifted hydrogen flame. Results of previous experiments are reported. The authors investigate the effects of partial premixing and of high turbulent transport rates on hydrogen combustion by examining the joint statistics of mixture fraction, temperature, and hydroxyl radical concentration. Measurements were made near the base of the lifted flame, in the intermittent region of the annular turbulent flame brush.

09 BIOMASS FUELS

0907 Resources

Refer also to citation(s) 46750

46740 (SERI/TP–232-3597) **Evaluation of available saline water resources in New Mexico for the production of microalgae.** Lansford, R.; Hernandez, J.; Enis, P.; Truby, D.; Mapel, C. Solar Energy Research Inst., Golden, CO (USA). Aug 1990. 83p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009511. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Researchers evaluated saline water resources in New Mexico for their suitability as sites for large-scale microalgae production facilities. Production of microalgae could provide a renewable source of fuel, chemicals, and food. In addition, making use of the unused saline water resources would increase the economic activity in the state. After analyzing the 15 billion acre-ft of unused saline water resources in the state, scientists narrowed the locations down to six sites with the most potential. With further analysis, they chose the Tularosa Basin in southern New Mexico as the best-suited area for 100-hectare microalgae production facility. 34 refs., 38 figs., 14 tabs.

0908 Production

46741 (EUR–12442) **Mechanized system for harvesting and processing of forest biomass in the degrated areas (PREBI-FOR): Final report.** De Pascali, P. (ICIE, Rome (Italy)); Gherardi, C.; Natalicchio, E. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 79p. Sponsored by

Commission of the European Communities. Contract EN-3B-0073-1(A). Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

A thorough study has identified the principal factors limiting utilization of Italy's woodland resources, particularly those of coppices, which have great potential. These factors can be found in other European areas. In parallel, a study has been made of the current state of the art in forest mechanization and organization. The results revealed in this document show the need to define a mechanized which would be suitable for the specific conditions of coppices, especially those on steeply sloping and degrated areas, and would be able to reduce costs markedly. The form of utilization best suited to this aim is reduction of the wood to the form of chips, which can be used in manufacturing activated charcoal, wood pump and chipboard, for which many European countries are at present almost totally dependent on imports. Use of wood chips in district heating plants is also an interesting possibility. Referring to the above, an outline design for a mechanized coppice harvesting system has been prepared and work relates and output have been estimated. Cost estimates show it to be more profitable than traditional harvesting system and able to undercut current prices for wood imports. 9 figs., 8 tabs.

46742 (GAO/RCED–90-87) **Tongass National Forest: Administration of two long-term Alaskan timber contracts.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 14p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

Two long-term timber contracts in the Tongass National Forest require private companies to harvest prescribed amounts of timber within agreed upon time frames during the 50-year contract life. This report has reviewed the accuracy of Forest Service figures for the volume of timber actually harvested under the two contracts, timber deleted from the private companies' operating plans, and backlogged timber. The author was unable to verify the first two figures because the Forest Service had not complied with all of its internal controls and because documentation and records were incomplete. The author was able to verify the figure for backlogged timber. While the Forest Service has tried to better account for timber prepared for harvesting through improved internal controls, this report believes additional actions are needed to ensure that forest supervisors comply with the internal controls for documenting harvested timber volumes and the information needed to support and report changes in timber sale activities is accurately reported.

46743 (GAO/T-RCED–90-45) **Information on timber harvesting, planting, federal assistance programs, and tax provisions.** Milans, F.H. General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 9p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report testifies that timber harvesting increased four percent from 1986 to 1988; tree planting and seeding increased 23 percent over this same period. About 90 percent of the increase in national tree planting and seeding came from increases in the number of trees planted under three Department of Agriculture programs that expanded rapidly over the period. This report looked at federal income tax provisions and found that they do affect the industry's calculation of taxable income. The Joint Committee on Taxation, for example, recently estimated that two such provisions reduce federal tax revenues by $460 million annually. The Forest Service projects that timber harvesting nationally will increase by more than one-half over the next 50 years, while the industry employment will drop by one-fourth due to increased labor productivity. These changes, however, may vary considerably by region.

0909 Processing

Refer also to citation(s) 46775, 47501, 47597

46744 (EUR–11382) **Pyrolysis as a basic technology for large agro-energy projects.** Mattucci, E. (ed.) (L'Aquila Univ. (Italy)); Grassi, G.; Palz, W. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 221p. Sponsored by Commission of the European Communities. (CONF-8710518–: Pyrolysis as a basic technology for large agro-energy projects workshop, L'Aquila (Italy), 15-16 Oct 1987). Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 17.50.

This document discusses activities and papers presented at a workshop held in L'Aquila (Italy) on October 15 and 16, 1987. The workshop was devoted to pyrolysis as a basic technology for large agro-energy projects. Topics discussed were: large European biomass energy projects; overview of pyrolysis technology and products; and technical presentations on pyrolysis. The individual papers have been cataloged separately. (FI)

46745 (EUR–12441) **Quality improvement of pyrolysis oils: Final report.** Churin, E. (Louvain Univ., Louvain-la-Neuve (Belgium). Unite de Catalyse et Chimie des Materiaux Divises); Grange, P.; Delmon, B. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 56p. Sponsored by Commission of the European Communities. Contract EN3B-0097-B. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The quality of the oils obtained by pyrolysis of biomass is not good enough to allow their use as a fuel at a commercial level. The possibility to improve the quality of these oils by a treatment under high pressure of hydrogen in the presence of a catalyst was evaluated. The first experiments indicated that a treatment in two stages facilitate the upgrading. During the first treatment effected at around 230°C the oil was "stabilized" and during the second treatment at around 380°C the conversion was extended. When the oil was processed alone the oxygen content was reduced by 70% and the volatile fraction represented 50%. When the oil was coprocessed with a hydrogen donor solvent (Tetralin) HDO was 85% and volatility was 95%. The presence of a hydrogen donor contributed to avoid the polymerization to heavy compounds and the deactivation of the catalyst. The most active catalyst was NiMo supported on alumina and promoted by phosphore. It showed a high deoxygenating and hydrogenating activity. A lesser but acceptable deoxygenation activity with low hydrogen consumption was obtained with a CoMo catalyst. A number of analytical technics were used in order to characterize the oil: IR and NMR spectroscopy, liquid and gas chromatography and mass spectrometry. The analysis showed that many substituted phenols and hydrocarbons comprising polyaromatic compounds were present in the oils. 42 refs., 11 figs., 23 tabs.

46746 (SERI/SP–231-3579, pp. 41-58) **Design and operation of an outdoor microalgae test facility.** Weissman, J.C. (Microbial Products, Inc., Vacaville, CA (USA)); Tillett, D.M. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

The Outdoor Test Facility of the Aquatic Species Program was completed during 1988. It features a small-scale system comprised of six 3-m^2 fiberglass ponds and a large-scale system with two 0.1 hectare raceway ponds. One of these is lined with a plastic membrane, the other with clay and rock. An engineering analysis of the hydraulic and carbonation systems of the 0.1 hectare ponds was performed. Velocity profiles, head losses, and power requirements were measured in each raceway. Manning's roughness coefficient was 0.010 for the plastic-lined pond and 0.0173 for the pond lined with earthen materials. Thus considerably less power was consumed in mixing the former. The overall efficiency of converting inorganic carbon into algal biomass was estimated to be 60% in the large raceways. Outgassing through the pond surface accounted for half of the loss of CO_2 at pH 7.5. The small-scale system was used to screen over fifteen strains of algae for yield in outdoor culture, to estimate annual yield at the site, and to evaluate capacity for production of lipids under nitrogen or silicon deprivation.

46747 The flash methanolysis of biomass (wood) for the production of ethylene and other carbonaceous products.

Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). pp. 42-43, Paper I & EC 137 of American Chemical Society, Division of Industrial and Engineering Chemistry, Inc. American Chemical Society, Washington, DC (US) (1990). (CONF-900402--: 199. national meeting of the American Ceramic Society, Boston, MA (USA), 22-27 Apr 1990).

The flash pyrolysis of biomass (wood) with methane was determined in a 1 inch I.D. x 8 ft long downflow tubular reactor. The major products formed were ethylene, BTX (mainly benzene), carbon monoxide and smaller amounts of ethane and carbon dioxide. The yields, based on the conversion of carbon in the wood to carbon in the products, for ethylene reached 23%, for BTX 20%, and for CO 40%. The yield of ethylene generally increased with temperature, decreased with pressure, and increased with methane to wood feed rate ratio.

46748 Biodegradation of trichloroethylene in continuous-recycle expanded-bed bioreactors. Phelps, T.J. (Univ. of Tennessee, Knoxville, (USA)); Niedzielski, J.J.; Schram, R.M.; Herbes, S.E.; White, D.C. *Applied and Environmental Microbiology (USA)*, 56(6): 1702-1709 (Jun 1990). DOE Contract AC05-84OR21400.

Experimental bioreactors operated as recirculated closed systems were inoculated with bacterial cultures that utilized methane, propane, and tryptone-yeast extract as aerobic carbon and energy sources and degraded trichloroethylene (TCE). Up to 95% removal of TCE was observed after 5 days of incubation. Uninoculated bioreactors inhibited with 0.5% Formalin and 0.2% sodium azide retained greater than 95% of their TCE after 20 days. Each bioreactor consisted of an expanded-bed column through which the liquid phase was recirculated and a gas recharge column which allowed direct headspace sampling. Pulses of TCE (20 mg/liter) were added to bioreactors, and gas chromatography was used to monitor TCE, propane, methane, and carbon dioxide. Pulsed feeding of methane and propane with air resulted in 1 mol of TCE degraded per 55 mol of substrate utilized. Perturbation studies revealed the pH shifts from 7.2 to 7.5 decreased TCE degradation by 85%. The bioreactors recovered to baseline activities within 1 day after the pH returned to neutrality.

46749 Photoenhanced anaerobic digestion of organic acids. Weaver, P.F. To United States Dept. of Energy, Washington, DC (USA). USA Patent 4,919,813/A/. 24 Apr 1990. Filed date 25 Aug 1989. USA Patent Application 7-398,604. Int. Cl. C02F 3/28. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a process for rapid conversion of organic acids and alcohols in anaerobic digesters into hydrogen and carbon dioxide, the optimal precursor substrates for production of methane. The process includes addition of photosynthetic bacteria to the digester and exposure of the bacteria to radiant energy (solar energy). The process also increases the pH stability of the digester to prevent failure of the digester. Preferred substrates for photosynthetic bacteria are the organic acid and alcohol waste products of fermentative bacteria. In mixed culture with methanogenic bacteria or in defined co-culture with non-aceticlastic methanogenic bacteria, photosynthetic bacteria are capable of facilitating the conversion or organic acids and alcohols into methane with low levels of light energy input.

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 46395, 46740, 46741, 46742, 46743, 46744

46750 (EUR-12102) **A prospective estimation of EEC agriculture from the point of view of energy production: Final report.** Becker, J.J. (Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets (CEMAGREF), 92 - Antony (France)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 108p. Sponsored by Commission of the European Communities. Contract EN3B-0048-F. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Development within the EEC of an agriculture specifically intended to produce energy would be a way of lessening the acute crisis in outlets for traditional agricultural productions. The economic advantages of such a policy can be appreciated if one assesses the cost of producing energy carriers from biomass and compares these to competing fossil energy prices. The aim of this study was to propose a prospective economic assessment of the most promising agro-energy lines, which take into account the impact of technical progress as regards raw material production and transformation. Comparison with data from the conventional energies sector as they appear in forecast studies enabled obtaining an idea of future profitability should this direction be taken for agriculture. 9 refs., 11 figs., 1 tab.

46751 (SERI/SP-231-3579, pp. 17-20) **CO_2 sources for microalgae-based liquid fuel production.** Feinberg, D.A. (Technology Development Associates, Inc., Golden, CO (USA)); Karpuk, M.E. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

The Solar Energy Research Institute's (SERI) Aquatic Species Program is developing microalgal species and culture technologies that result in microalgal cells with a high percentage of lipids. The lipids can be extracted and converted to a diesel fuel substitute. Optimal microalgae growth occurs in CO_2 saturated solutions. If these research efforts are successful, large quantities of low-cost CO_2 will be needed. The purpose of this study is to identify possible CO_2 sources for microalgae-based fuel production and to quantify the amounts available and possible costs. Because of the early stage of development of the fuel synthesis technology, and the current plentiful supplies of gaseous and liquid fossil fuels, the year 2010 was chose as the earliest date that CO_2 for fuel synthesis would be needed.

46752 (SERI/SP-231-3579, pp. 21-37) **The economic impact of brine disposal on algal fuel facilities.** Bergeron, P. (Solar Energy Research Institute, Golden, CO (USA)). Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

Three brine disposal options were found that may be environmentally and economically acceptable: deep-well injection; transport by pipeline to the ocean or other large body of saline water; and containment in evaporation ponds as described in studies by the Bureau of Reclamation. The selection of an alternative for a particular algal fuel facility site depends on the topography, geology, and remoteness of that site. Transport by rail or truck does not appear to be an economically viable option. The possibility of generating revenue by producing salable salts, potable water, and electricity (via solar pond power plants) was investigated, but found to be economically unattractive unless the prices of the competition increase considerably. In general, the greater the distance to an environmentally acceptable disposal site and the higher the salinity of the feed water to the algae production ponds, the greater the cost of brine disposal to the algal fuels facility. Overall, brine disposal is not an intractable problem for microalgae farming for fuel, and can be handled by existing technologies.

0950 Environmental Aspects

46753 (PB-90-246364/XAB) **Summary of new-technology wood-stove in-house performance. Report for September 1988-July 1989.** McCrillis, R.C. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1989. 17p. (EPA-600/D-90/056). Source: NTIS, PC A03/MF A01.

The paper summarizes the in-house performance of new technology woodstoves. Use of wood as a residential heating fuel increased markedly in the U.S. during the 1970s in response to an increase in fossil fuel costs. Most of the increase represented wood burned in airtight parlor stoves which are generally operated air-starved, leading to low combustion efficiency and the release of substantial quantities of unburned organics into the atmosphere. Field studies over the past several years have quantified emission rates from new technology stoves designed to significantly reduce

the quantity of unburned organics released. The new stoves, employing either catalytic or noncatalytic secondary combustion features, are currently mandated by the U.S. EPA. These studies have shown that the new technology stoves, while reducing emissions, do not achieve the emission reduction expected. Studies during the winter of 1988-89 showed that emission control was gradually improving, but they also showed that some stove models were experiencing degraded emission control performance after only a few months use.

0980 Waste Management

Refer also to citation(s) 47075

0990 Products and By-Products

Refer also to citation(s) 46740, 46744

10 SYNTHETIC FUELS

Refer also to citation(s) 47184

1003 Properties and Composition

46754 Electrochemistry and redox chemistry of $H_2OFe^{III}SiW_{11}O_{39}^{5-}$ in the presence of H_2O_2 and OH. Toth, J.E. (California Institute of Technology, Pasadena (USA)); Anson, F.C.; Melton, J.D.; Cabelli, D.; Bielski, B.H.J. *Inorganic Chemistry (USA)*, 29(10): 1952-1957 (16 May 1990). DOE Contract AC02-76CH00016.

Heteropolytungstates in which one of the positions normally occupied by a tungsten cation is occupied instead by an iron cation are shown to be catalysts for the electroreduction of H_2O_2. The rate constant governing the reduction of H_2O_2 by $H_2OFe^{II}SiW_{11}O_{39}^{6-}$ was measured, and a catalytic mechanism involving an Fe(IV) intermediate generated from the reaction between the Fe(III) form of the heteropolytungstate anion and hydroxyl radicals is presented. The Fe(IV) intermediate can react with itself to produce H_2O_2 and the Fe(III) form of the heteropolytungstate. Alternatively, the Fe(IV) intermediate can consume additional H_2O_2 by oxidizing it to O_2. Competition between these two reaction pathways accounts for the nonintegral stoichiometry observed under some experimental conditions during the electroreduction of H_2O_2 catalyzed by $H_2OFe^{II}SiW_{11}O_{39}^{6-}$. Pulse-radiolysis experiments were employed to detect the Fe(IV) intermediate, to evaluate rate constants for the reactions in which it is formed and decomposed, and to measure the rate of reduction of the Fe(III) form of the heteropolytungstate by O_2^-. 21 refs., 3 figs., 3 tabs.

13 HYDRO ENERGY

1301 Resources and Availability

46755 (ETSU-SSH–4030) **Small-scale hydro-electric potential of Wales.** UKAEA Harwell Lab. (UK). Energy Technology Div. Oct 1990. 131p. Order Number DE90519537. Source: NTIS (US Sales Only), PC A07/MF A01.

Over 560 small hydro-electric sites have been identified throughout Wales, each of an installed capacity greater than 25kW. Each site, individually visited, has been assessed to take account of the particular site conditions including the impact on amenity and environment, the ease of access, the topography of the site, the engineering difficulties and the water flow conditions. Although the capacity and energy available at each site have been conservatively estimated, they do represent practical, exploitable values. The methodology includes the use of standardized, regional flow duration curves to generate the capacity and energy characteristics of each site. In total these sites could provide about 300GWh of energy each year from an installed capacity of about 63MW. (author).

46756 (PB–90-215245/XAB) **HEC-5: Simulation of flood control and conservation systems user's manual (without Exhibit 8). Final report.** Hydrologic Engineering Center, Davis, CA (USA). May 1983. 243p. (CPD–5A). Source: NTIS, PC A11/MF A02.

For system on diskette, see PB–90-502428.

HEC-5 is designed to simulate the sequential operation of a reservoir-channel system with a branched network configuration. Any time interval from one minute to a month can be used, and multiple time intervals can be used within a single simulation. Channel routing can be performed by any of seven hydrologic routing techniques. Reservoirs operate to minimize downstream flooding; evacuate flood control storage as quickly as possible; provide for low-flow requirements and diversions; and meet hydropower requirements. Hydropower requirements can be defined for individual projects or for a system of projects. Pump-storage operation can also be simulated. Sizing of conservation (water supply and hydropower) storage can be automatically performed using the safe yield concept, and economic computations can be provided for hydropower benefits and flood damage evaluation. It includes the capability to read and write time-series data to the HEC-DSS (data storage system).

46757 (PB–90-215252/XAB) **HEC-5: Simulation of flood control and conservation systems. Exhibit 8 of user's manual-Input description. Final report.** Hydrologic Engineering Center, Davis, CA (USA). Dec 1989. 125p. Source: NTIS, PC A06/MF A01.

For system on diskette, see PB–90-502428.

The documentation contains a detailed description of each variable on each input record for an HEC-5 input data file. It also contains a Functional Use Index that can be used to determine which input variables are required for specific tasks. A Summary of Input Records shows the sequential arrangement of input records.

46758 (PB–90-215260/XAB) **INFIVE: Interactive input-preparation program for HEC-5, user's manual. Final report.** Hydrologic Engineering Center, Davis, CA (USA). Jul 1987. 82p. Source: NTIS, PC A05/MF A01.

For system on diskette, see PB–90-502428.

INFIVE is an interactive program that generates an HEC-5 input data file by asking the user a series of questions about the reservoir system. The input file created by INFIVE contains all of the records needed for simulation in the proper sequence, but does not contain all of the specific data that is required to execute HEC-5. The user subsequently fills in the data fields by using an editor (such as COED).

46759 (PB–90-215278/XAB) **CKHEC5: Input data checking program for HEC-5. User's manual. Final report.** Hydrologic Engineering Center, Davis, CA (USA). Jun 1987. 55p. Source: NTIS, PC A04/MF A01.

For system on diskette, see PB–90-502428.

CKHEC5 is designed to check HEC-5 input data for various errors based on instructions in the HEC-5 User's Manual.

46760 (PB–90-215286/XAB) **COED: Corps of Engineers editor. Final report.** Hydrologic Engineering Center, Davis, CA (USA). Feb 1987. 75p. Source: NTIS, PC A04/MF A01.

For system on diskette, see PB–90-502428.

COED is an editor containing full-screen editing capabilities, along with a powerful line-oriented command set that can be executed interactively or in a batch mode. COED is functional for most general text editing necessary for data preparation and program development.

46761 (PB–90-502428/XAB) **HEC-5: Simulation of flood control and conservation systems (for microcomputers). Model-Simulation.** Bonner, V.R. Hydrologic Engineering Center, Davis, CA (USA). Jan 1989. vp. Source: NTISCP D05.

System: IBM PC/XT Compatible; DOS 3.0 or later operating system, 640K. Language: FORTRAN 77. One 5 1/4 floppy disk drive; 10Mb (or larger) hard disk of which 6Mb available for entire package of programs; math coprocessor (8087,80287,80387) required. One Mb of extended memory should improve execution speed by 3-4 times. PKUNZIP.EXE is used to decompress files that have the .ZIP extension.; The software is contained on 8 360K 5 1/4 inch

diskettes, double density. File format: ASCII label. Price includes documentation, PB–90-215245, PB–90-215252, PB–90-215260, PB–90-215278 and PB–90-215286.

HEC-5 is designed to simulate the sequential operation of a reservoir-channel system with a branched network configuration. Any time interval from one minute to a month can be used, and multiple time intervals can be used within a single simulation. Channel routing can be performed by any of seven hydrologic routing techniques. Reservoirs operate to minimize downstream flooding; evacuate flood control storage as quickly as possible; provide for low-flow requirements and diversions; and meet hydropower requirements. Hydropower requirements can be defined for individual projects or for a system of projects. Pump-storage operation can also be simulated. Sizing of conservation (water supply and hydropower) storage can be automatically performed using the safe yield concept, and economic computations can be provided for hydropower benefits and flood damage evaluation. It includes the capability to read and write time-series data to the HEC-DSS (Data Storage System)...Software Description: The model is written in the Fortran 77 programming language for implementation on an IBM PC/XT or compatible using the DOS 3.0 operating system.

1303 Plant Design and Operation

46762 (PB–90-230418/XAB) **Review of power operation and maintenance program. Review report.** Bureau of Reclamation, Denver, CO (USA). Jan 1990. 17p. Source: NTIS, PC A03/MF A01.

Also available from Supt. of Docs. See also PB–90-187378.

The report describes the power operation and maintenance program at the Yuma Desalting Plant, Parker Power Plant, Davis Power Plant, and Hoover Power Plant.

1306 Environmental Aspects

46763 (DOE/BP/63584–3, pp. 5-52) **Report A. Oregon Department of Fish and Wildlife.** Beamesderfer, R.C. (Oregon Department of Fish and Wildlife, Portland (USA)); Elliott, J.C.; Foster, C.A. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Oregon Dept. of Fish and Wildlife, Portland, OR (USA). Sep 1989. In *Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam. Annual progress report, April 1988–March 1989.* Order Number DE90004334. Source: NTIS, PC A10/MF A01.

We report on our effort from April 1988 to March 1989 to describe the life history and dynamics of white sturgeon Acipenser transmontanus in The Dalles and Bonneville reservoirs. We set 674 setlines in The Dalles Reservoir and 170 setlines in Bonneville Reservoir. We caught 1,586 white sturgeon in The Dalles Reservoir and 484 in Bonneville Reservoir. Catch per unit effort varied among areas of the reservoir. Our setlines were size selective. We recaptured 89 fish released in 1987 and 82 fish released in 1988. Spaghetti tags and barbel clips were the most persistent marks we examined. Extensive movements within the reservoir were observed for marked sturgeon. We aged fish as old as 46 and report on the uncertainty of our aging method. We estimated parameters in a length weight equation. Approximately 2.4% of the white sturgeon we examined were females that contained developing eggs.

46764 (DOE/BP/63584–3, pp. 53-100) **Report B. Washington Department of Fisheries.** LaVoy, L. (Columbia River Fisheries Laboratory, Battle Ground, WA (USA)); James, B.; Hale, D. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Oregon Dept. of Fish and Wildlife, Portland, OR (USA). Sep 1989. In *Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam. Annual progress report, April 1988–March 1989.* Order Number DE90004334. Source: NTIS, PC A10/MF A01.

Washington Department of Fisheries (WDF) censused the recreational fisher in Bonneville and The Dalles reservoirs for mark recovery, biological samples, and harvest data on white sturgeon Acipenser transmontanus from March through October, 1988. Total harvest of white sturgeon was 1,135 in Bonneville Reservoir and 863 in the Dalles Reservoir during this period. Samples interviewed 4,654 anglers in Bonneville Reservoir and 7.748 anglers in the Dallas Reservoir. Biological sampling was conducted on 19.9% of the harvest in Bonneville Reservoir and 28.2% in The Dalles Reservoir. Samplers examined 255 harvested white sturgeon for marks during the Bonneville Reservoir census and none had been marked/tagged by Oregon Department of Fish and Wildlife. During The Dalles Reservoir census, 241 harvested white sturgeon were examined of which 19 were marked. WDF continued efforts towards describing the population dynamics of white sturgeon downstream of Bonneville Dam. WDF assisted National Marine Fisheries Service in assessing reproduction and early life history of white sturgeon downstream of Bonneville Dam. WDF processed and staged samples of eggs and larvae collected in 1988. Ives Island, a primary spawning area about 2.5 miles downstream of Bonneville Dam, was recommended as a site to concentrate field sampling in order to identify critical environmental factors affecting early life history of white sturgeon.

46765 (DOE/BP/63584–3, pp. 101-166) **Report C. U.S. Fish and Wildlife Service.** Parsley, M.J.; Duke, S.D.; Underwood, T.J.; Beckman, L.G. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Oregon Dept. of Fish and Wildlife, Portland, OR (USA). Sep 1989. In *Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam. Annual progress report, April 1988–March 1989.* Order Number DE90004334. Source: NTIS, PC A10/MF A01.

White sturgeon spawning occurred in the tailraces of John Day and The Dalles dams in 1988, though recruitment to young-of-the-year appears to have failed in both pools. Spawning behavior downstream from The Dalles Dam was observed and verified on 3 June by the collection of adhesive eggs immediately downstream from the area of activity. We collected 25 eggs and 14 larvae of white sturgeon from 13 June through 14 July from the John Day Dam tailrace and 156 eggs and 13 larvae from 25 May through 29 July from The Dalles Dam tailrace. Spawning probably occurred on at least 4 days in the John Day Dam tailrace and on at least 25 days in The Dalles Dam tailrace based on back-calculated ages of eggs and larvae collected. No post-larval, young-of-the-year, or age I white sturgeon were captured from either pool despite intense effort with the trawls. We captured 484 white sturgeon with trawls in The Dalles Pool and 860 white sturgeon in Bonneville Pool. Catches in both pools varied spatially and temporally. We also captured 62 white sturgeon from backwater areas of Bonneville Pool with gill nets as part of an expanded effort to estimate habitat use by white sturgeon. Availability of suitable microhabitats for spawning and embryo incubation may affect year-class strength. Younger age groups of white sturgeon, though, appear to be generalists in their habitat requirements.

46766 (DOE/BP/63584–3, pp. 167-207) **Report D. National Marine Fisheries Service.** McCabe, G.T. Jr. (Northwest Fisheries Center, Seattle, WA (USA)); Hinton, S.A.; McConnell, R.J. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Oregon Dept. of Fish and Wildlife, Portland, OR (USA). Sep 1989. In *Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary Dam. Annual progress report, April 1988–March 1989.* Order Number DE90004334. Source: NTIS, PC A10/MF A01.

Under the agreement with the Oregon Department of Fish and Wildlife, the National Marine Fisheries Service (NMFS) is responsible for describing the reproduction and early life history of white sturgeon populations, and defining habitat requirements for all life stages of white sturgeon and to quantify available habitat. The NMFS's research is being done in the Columbia River downstream from Bonneville Dam–the Columbia River's only reach known to support all white sturgeon developmental stages in sufficient numbers to provide a control against which habitat availability and use between Bonneville and McNary dams can be compared. Also, NMFS and the Washington Department of Fisheries are attempting to determine the effect of variable flows at Bonneville Dam on the downstream displacement of white sturgeon eggs and larvae. Specific research goals for 1988 were (1) to determine the spawning requirements of white sturgeon in the Columbia River downstream

from Bonneville Dam; (2) to define the boundaries (based on substrate) of white sturgeon spawning areas in the Columbia River downstream from Bonneville Dam; (3) to determine the downstream distribution of white sturgeon larvae in the Columbia River downstream from Bonneville Dam; and (4) to determine the habitat requirements or preferences of juvenile white sturgeon in the Columbia River downstream from Bonneville Dam. This report describes progress on NMFS's studies from March 1988 to March 1989.

1307 Power-Conversion Systems

Refer also to citation(s) 46730

46767 (ETSU-SSH-4048-P3) **An assessment of the Borrowash pneumatic low head hydro project.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Binnie and Partners, London (UK). 1990. 39p. Order Number DE90519538. Source: NTIS (US Sales Only), PC A03/MF A01.

An assessment is made of a novel device for use in low-head hydropower. It utilizes a membrane to separate air from the flow of water and this drives a Wells turbine. Problems encountered with the prototype are reported and estimates given for the overall efficiency. Each stage within the conversion of the water flow to electrical energy is analyzed to identify the extent of the associated efficiency loss. (UK).

14 SOLAR ENERGY

1405 Solar Energy Conversion

Refer also to citation(s) 46971, 47264

46768 (AFME-87-11-0028) **Electronic and solar grade silicon, vol. 1: Proceedings.** Huong, P.V. (ed.). Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France). Mar 1987. 156p. (In French). (CONF-8703173--: 2. national colloquium on silicon, Paris (France), 9-11 Mar 1987). Order Number DE90518432. Source: NTIS (US Sales Only), PC A08/MF A01.

Fifteen communications of a symposium concerning silicon technology and research are presented: silicon fabrication with plasmas, refractory metal silicides for VLSI technology, zone fusion for silicon on insulants, GaAs epitaxial growth on be coated silicon substrates, transfer properties of hydrogenated amorphous silicon, RAD silicon ribbons, diffusion and impurities, heterogeneities and diffraction in hydrogenated amorphous silicon, thin films silicon, amorphous silicon transistors for flat display, integrated circuits future technological needs.

46769 (SERI/SP-231-3579, pp. 61-69) **Culture collection status.** Brown, L.M. (Solar Energy Research Institute, Golden, CO (USA)). Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

A total of 2,367 strains representing the significant strains collected by the program have been screened. This brings the collection and screening phase of the Aquatics Species Subprogram to a close. Further efforts will be directed to the application of genetic engineering techniques to improve lipid yield in rapidly growing strains. This approach is a proven strategy yield improvement which is widely used in industrial microbiology.

46770 (SERI/SP-231-3579, pp. 71-81) **Characterization of growth and lipid yield in microalgae from the Southwest using high salinity media.** Ellingson, S.B. (Arizona State Univ., Tempe (USA)); Tyler, P.L.; Sommerfeld, M.F. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

A screening and characterization protocol incorporating high salinity and temperature was employed to rapidly reduce the number of microalgal strains collected in the Aquatic Species Program to those with the greatest potential as lipid producers. Initial screening using a RCD (Rotary Culture Device) and Nile Red staining originally isolated procedure successfully reduced the approximately 1,400 strains in the culture collection to approximately 800. Of the 800 strains selectively screened, only 102 survived the protocol. Forty strains were capable of growth in both types of media. The average growth rate in SERI Type I Medium was significantly greater than in Type II Medium, averaging 1.04 doublings/day compared to 0.83 doublings/day, respectively. Intracellular lipid accumulations were evaluated fluorometrically using the dye Nile Red during logarithmic growth. Lipid yield for the microalgae were similar in the two media. Lists of the 10 best strains based on growth characteristics, lipid yield and a combination of these factors were prepared. When the strains were compared, the microalgae that accumulated the greatest quantity of lipids were not the most rapidly growing, but those typically growing at between one and two doublings/day. However, a comparison of total yield from logarithmically-growing cultures with yield from stressed cultures suggests that the ability to accumulate substantial lipid during relatively rapid growth may be as desirable as accumulating much larger lipid reserves under stress.

46771 (SERI/SP-231-3579, pp. 85-89) **Strategies for genetic improvement of microalgae with ability to grow in outdoor mass culture.** Brown, L.M. (Solar Energy Research Institute, Golden, CO (USA)); Dunahay, T.G.; Jarvis, E.E. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

There are many strains of microalgae in the SERI Culture Collection with proven ability for rapid growth in outdoor culture. Also, most of these strains can be induced to accumulate large quantities of lipid under nutrient stress. The goal of genetics research at SERI is to be able to control more easily the accumulation of lipids by microalgae and thus achieve higher lipid contents in outdoor mass culture. The tools of modern molecular biology are being applied to this work in order to clone some of the key genes which regulate lipid biosynthesis and to find ways to introduce genetic material into the microalgae and have these genes expressed.

46772 (SERI/SP-231-3579, pp. 91-118) **The mitochondrial genome of the exsymbiotic Chlorella-like green alga N1a.** Waddle, J.A. (Univ. of Nebraska, Lincoln (USA)); Schuster, A.M.; Lee, K.W.; Meints, R.H. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

Mitochondrial (mt) DNA from the unicellular, exsymbiotic Chlorella-like green alga, strain N1a was isolated and cloned. The mtDNA has a buoyant density of 1.6919 g/cc in CsCl and an apparent G/C base composition of 32.5%. The genome contains approximately 76 kbp of DNA based on restriction fragment summation and electron microscopic measurements. A map using four site-specific endonucleases was generated. From mapping studies the genome is presented as a circular molecule and appears as such under the electron microscope. Eight genes were assigned to the map as demonstrated by heterologous hybridization using mt encoded specific probes. These include the genes for subunits 6, 9, and alpha of the F_0-F_1 ATPase complex, the large and small subunit rRNAs, cytochrome oxidase subunits I and II, and apocytochrome b.

46773 (SERI/SP-231-3579, pp. 121-134) **Purification and characterization of acetyl-CoA carboxylase from the diatom Cyclotella cryptica.** Roessler, P.G. (Solar Energy Research Institute, Golden, CO (USA)). Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

Malonyl-CoA, the precursor used for the biosynthesis of fatty acids, is produced via the action of the enzyme acetyl-CoA carboxylase. Since previous research has suggested that this enzyme plays a key role in the regulation of lipid biosynthetic rates in the diatom Cyclotella cryptica, it was of interest to investigate the physical, chemical, and kinetic properties of acetyl-CoA carboxylase from this species. The results from this and similar studies will be necessary before microalgal species can be genetically engineered for higher lipid production rates in outdoor mass culture.

46774 (SERI/SP–231-3579, pp. 135-154) **Triglyceride accumulation and the cell cycle in microalgae.** Cooksey, K.E. (Montana State Univ., Bozeman (USA)); Guckert, J.B.; Thomas, R. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

Triglyceride (TG) storage lipid is the only lipid which accumulates in microalgae during exposure to stresses which inhibit algal cell cycles. This inhibition has most often been induced by nutrient limitations such as depletion of nitrogen for green algae and silicate for diatoms. No direct mechanism has been described for low nutrient-induced lipid accumulation. In this work, we report that alkaline pH stress results in triglyceride accumulation. This accumulation was independent of medium nitrogen or carbon levels. Like nutrient deprivation, it is apparent that the high pH has only an indirect effect on lipid accumulation. Based on morphological observations, it is apparent that in Chlorella CHOR-1, alkaline pH inhibits autospore release. We propose that triglyceride accumulation in microalgae could be based on a synthesis/utilization cycle which is constitutive within the cell division cycle, as opposed to a specifically-induced synthesis of triglyceride. The alkaline pH stress effects lipid accumulation by inhibiting the cell division cycle prior to triglyceride utilization and before autospore release. If synthesis continues beyond utilization, the result is an accumulation of triglyceride. Cells inhibited in this manner show a polar and glycolipid fatty acid profile somewhat similar to that of neutral lipid i.e. fatty acids are shorter in chain length and less unsaturated than in polar and glycolipids of control cells.

46775 (SERI/SP–231-3579, pp. 157-164) **Microalgal fuel production processes: Analysis of lipid extraction and conversion methods.** Nagle, N. (Solar Energy Research Institute, Golden, CO (USA)); Lemke, P. Solar Energy Research Inst., Golden, CO (USA). Sep 1989. In *Aquatic species program. Annual report.* Order Number DE89009472. Source: NTIS, PC A08/MF A01.

Microalgae are unique photosynthetic organisms that are known to accumulate storage lipids in large quantities and thrive in saline waters. Before these storage lipids can be used they must first be extracted from the microalgae and converted into usable fuel. Transesterification of lipids produces fatty acid methyl esters that can be used as a diesel fuel substitute. Three solvents, 1-butanol, ethanol, and hexane/2-propanol were evaluated for extraction efficiency of microalgal lipids. Type of catalyst, concentration of catalyst, time of reaction, temperature of reaction, and quality of lipid were examined as variables for transesterification. The most efficient solvent of the three for extraction was 1-butanol (90% efficiency), followed by hexane/2-propanol and ethanol. Optimal yield of fatty acid methyl esters was obtained using 0.6 N hydrochloric acid in methanol for 0.1 h at 70°C.

46776 (SERI/TP–210-3833) **SERI preprints for the 21st IEEE photovoltaic specialists conference.** Solar Energy Research Inst., Golden, CO (USA). Jun 1990. 152p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-900542–Exc.: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90000341. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This document contains conference papers prepared by SERI staff members for the 21st Institute of Electrical and Electronics Engineers (IEEE) Photovoltaic Specialists Conference, which was held in Kissimmee, Florida, on May 21–25, 1990. The papers presented here have been reproduced as submitted for the conference proceedings. They cover a wide range of SERI photovoltaic research areas. Each report will be individually cataloged.

46777 (STEV-NYEL–90-5) **Solar cells for energy production.** Andersson, Mats (Institutet foer Mikroelectronik, Kista (SE)); Hedstroem, Jonas; Jargelius, M.; Niemi, Esko; Sigurd, D.; Stolt, L. Statens Energiverk, Stockholm (Sweden). 1990. 59p. (In Swedish). Project STEV-411-503. Order Number DE90518767. Source: NTIS (US Sales Only), PC A04/MF A01.

At the Swedish Institute of Microelectronics the effort towards an efficient polycrystalline thin film tandem cell continues. Our bottom cell consisting of Cds - $CuInSe_2$ has reached 10% efficiency with a double layer AR coating. The double layer absorber structure necessary to obtain high efficiencies in this type of cell has been investigated as well as deposition and doping processes for the window layer. The main thrust is now directed towards developing a top cell deploying $CuGaSe_2$ as an absorber. Still at an early stage, over 5% efficiency at AM 1.5 has been achieved. An XPS equipment is now ready for in situ analysis of cells at different stages of deposition. In particular, studies of the heterojunction interface and absorber diffusion properties will be conducted.

46778 (STEV-NYEL–90-6) **Final report. Project solar cells EG.** Andersson, Mats (Institutet foer Mikroelektronik, Kista (SE)). Statens Energiverk, Stockholm (Sweden). 4 Jan 1990. 38p. Project STEV-411-530. Order Number DE90518768. Source: NTIS (US Sales Only), PC A03/MF A01.

During three years the Swedish Institute of Microelectronics (IM) has been involved in a project in co-operation with the Commision of the European Communities (CEC) concerning exchange of data from photovoltaic installations. Each month, IM has delivered diskettes with plant data from the 2 kWp grid-connected photovoltaic (PV) plant in Huvudsta, Stockholm, to Joint Research Centre (JRC) in Ispra, Italy. This plant was designed and built 1984 and has been in operation during five years without any problems. 48 modules with polycrystalline cells are installed on an apartment house in Huvudsta, Stockholm. The energy from the modules is converted to AC by an inverter and is fed to the grid. The yearly average DC-production is 1700 kWh and approximately 1300 kWh of AC-energy is fed into the grid. IM has participated in two meetings with the European Working Group on PV Plant Monitoring (EWG/PPM). This group was established 1985 to address the issues raised by the monitoring programme and to provide technical support to the PV programmes of the CEC.

1406 Photovoltaic Power Systems

Refer also to citation(s) 46777

46779 (ECN-I–90-028) **Solar energy project Zaire.** Muis, R.P. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1990. 18p. Order Number DE90519654. Source: NTIS (US Sales Only), PC A03/MF A01.

The foundation 'Pygmeeen Kleinood' in Schoorl, Netherlands, which is dedicated to the destiny of the pygmys in East Zaire, succeeded in transporting a photovoltaic energy system of the firm R and S (Eindhoven, Netherlands) to Zaire and placing it on the roof of an obstetric clinic of the 'Centre de Sante' of Papa Kisangani in Komanda. This system with cooling for medicines is suitable for the tropics. It was built at ECN (Netherlands Energy Research Foundation), and with the help of the Business Unit Renewable Energies checked for functional specifications in order to gain experience of assembling the system. The system was installed by ECN April 1990 and put into operation. The solar cells, the cooling system and the batteries operate as planned, except for the lighting system. 5 figs.

46780 (NEDO-P–8926) **Effects of small scale PV systems on power system operation and planning.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 92p. (In Japanese). Order Number DE90517228. Source: NTIS (US Sales Only), PC A05/MF A01.

This report examined effects of the introduction of small scale Photovoltaic (PV) systems installed by customers on power system. Control of power system for fuel-fired multiple generating sets consists of economical load dispatching control (EDC) to determine each generator output so that total fuel cost becomes minimum and of load frequency control (LFC) to control the change of frequency and interconnecting tie power flow within the allowable values. If PV output changes suddenly, the economy of power generating cost decreases owing to the change of load dispatching value and deviation of base value. Further, controlled results for frequency and interconnection power flow in LFC deteriorate. The economy deteriorates also owing to the retention of excess reserve equipments based on the enlargement of demand forecasting error. For the power source planning, reduction of peak resources accompanied by peak load decrease or uncertain power source

planning will ocuur. When the effect of PV introduction on power demand and supply is evaluated, it is important to consider the difference of solar radiation (weather difference and cloud movement, etc.) based on regional width. 14 refs., 34 figs., 12 tabs.

1407 Solar Thermal Power Systems

Refer also to citation(s) 47069

1409 Solar Thermal Utilization

Refer also to citation(s) 46971, 46979

1410 Solar Collectors and Concentrators

Refer also to citation(s) 47070

15 GEOTHERMAL ENERGY

1501 Resources and Availability

46781 (NEDO-P-8912) **Survey of possibility for volcanic energy development.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 315p. (In Japanese). Order Number DE90517230. Source: NTIS (US Sales Only), PC A14/MF A01.

Volcanic areas, clarification of heat source structure, evaluation of resources and problems on utilization techniques were arranged to search the possibility of future volucanic heat source. It is necessary to improve the exploration accuracy by combining geophysical exploration with geological and geochemical surveys in order to explorate a magma reservoir. Especially, seismic exploration is effective. The surveying procedure is as follows: confirmation of magma existence and grasping the whole image, evaluation of resources, clarification of 3-dimensional distribution of magma in a promising area, and heat structure survey by heat flow measurement and others to construct more accurate model for resources. This model is verified finally by practical drilling. Promising areas which are worthy of development, are active volucanic areas in Kyushu, Hakkoda nad Hokkaido. It is desirable to make drilling to the depth of 3km or magma reservoir to develop the future heat source. It is also required to improve the thermal resistance and corrision resistance of materials to be used. Heat extraction by a single well is most realistic and the closed coaxial double pipe heat exchanger or open heat exchanger in the well will be used to improve the extraction. 230 refs., 139 figs., 36 tabs.

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 47556

1510 Direct Energy Utilization

46782 (EUR-12345) **Geothermal energy—Southampton: Demonstration project: Final report.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Southampton Geothermal Heating Co., Crawley (UK). ©1989. 30p. Sponsored by Commission of the European Communities. Contract GE 607/83-UK. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

The aim of the project is the use of the geothermal source to provide heating for office buildings, schools, shopping centers, commercial premises and dwellings located near the City Center of SOUTHAMPTON. After the completion of the drilling, the geological scientists decided to retain the figure of 12 liters/second as the operational capacity of the well. The Southampton Geothermal Heating Company was created to promote a district heating. Heat is produced from the Heat Station where a 2 MW geothermal heat exchanger is installed close to a 250 kVA diesel engine with heat recovery and a 2 MW dual fuel boiler. The Heat Station is controlled by a fully automatic system which manages the energies and records the operation parameters. The system is designed to use the geothermal resource as priority. The internal heating system in each consumer's building was not changed; heat exchangers were only installed inside the consumer's boiler houses and connected to the district heating mains; existing boilers are kept for peak demands and stand-by. All the buildings located in the City Center represent such a potential heat consumption that the level of 1 500 t.e.p./year of substituted energy can be envisaged in the further stages. The operation of the scheme successfully began in March 86; since that date, the geothermal source has contributed to the heating of the Southampton City Council and Hampshire County Council. This project is the first one in the UNITED KINGDOM for the use of the geothermal resource and the application to a district heating. 13 figs., 2 tabs.

1520 Geothermal Data and Theory

46783 (PB-90-241837/XAB) **Chemistry of submarine hydrothermal solutions at 21° north, East Pacific Rise and Guaymas Basin, Gulf of California. Doctoral thesis.** Von Damm, K.L. Woods Hole Oceanographic Institution, MA (USA). ©Aug 1983. 243p. Grants NSF-OCE-8020203, NSF-OCE-8118481. (WHOI-84-3). Source: NTIS, PC A11/MF A02.

The chemistry of hydrothermal solutions at 21 north, East Pacific Rise and Guaymas Basin, Gulf of California was determined. In contrast to the 21 N systems where the solutions exit directly from basalt, the hydrothermal systems at Guaymas pass through and react with approximately 500 meters of sediment cover before they exit on the seafloor. At 21 N, four vent areas with a maximum temperature of 355 C were sampled and at Guaymas, ten vent areas with a maximum temperature of 315 C were sampled. The hot springs at both sites are black smokers. The 21 N solutions are acid (pH = 3.3-3.8, 25 C, 1 atm), reducing (H_2S = 6.6-8.4 m moles/kg) and metal rich (Fe up to 2.4 m moles/kg). The Guaymas solutions are less acid (pH = 5.9, 25 C, 1 atm) and metal rich (Fe < 0.18 m moles/kg). The higher pH and extremely high alkalinity (2.8-10.6 meq/kg) at Guaymas can be attributed to dissolution of $CaCO_3$ and thermal degradation of organic matter which occur in the sediment column. The high pH and alkalinity are responsible for the lower concentrations of the metals which form insoluble sulfides and these are probably deposted within the sediment cover. Quartz geobarometry implies a depth of reaction within the oceanic crust of 0.5-3.5 kms for the two areas; in agreement with the geophysical estimates for the 21 N site.

46784 **Simultaneous analyses of noble-gas isotopes and halogens in fluid inclusions in neutron-irradiated quartz veins by use of laser microprobe noble-gas mass spectrometer.** Bohlke, J.K. (CMT-205, Argonne National Laboratory, Argonne, IL (US)); Kirschbaum, C.; Irwin, J. pp. 61-88 of New frontiers in stable isotopic research: Probes, ion probes, and small-sample analysis. Shanks, W.C.; Criss, R.E. US Geological Survey, Denver, CO (USA) (1988). (CONF-8801176--: New frontiers in stable isotopic research: laser probes, ion probes, and small sample analysis, Reston, VA (USA), 12-13 Jan 1988).

This paper discusses a high-sensitivity noble-gas mass spectrometer combined with a laser sampler that has been adapted to analyze natural and neutron-induced Ar, Kr, and Xe isotopes released from fluid inclusions in minerals. Aqueous fluid inclusions in Cretaceous vein quartz are analyzed and data are presented.

16 TIDAL AND WAVE POWER

1605 Environmental Aspects

46785 (ETSU-TID-4067) **Computer modelling of intertidal mudflats areas.** UKAEA Harwell Lab. (UK). Energy Technology Div. 1990. 83p. (HR-EX-1962). Order Number DE90519539. Source: NTIS (US Sales Only), PC A05/MF A01.

Sites which have prospects for tidal power generation almost inevitably have large expanses of intertidal sand banks or mud flats

due to the large tidal ranges. These intertidal areas are usually the natural habitats for many species of marine flora and fauna so it is important to assess how they may be affected by tidal barrages. The objective of this project is to improve the computer modelling of water movements in such areas as input to associated sedimentation, water quality and ecology studies. The first stage of the work involved the formulation of computer techniques for improving the model simulation using a sub-grid geometry data base. The second and third stages involved the setting up of the database and a 'standard' 300m mathematical model to provide a benchmark for demonstrating the efficacy of the new techniques. The fourth stage involved the application of the new techniques in a new computer model of the estuary and validating the results against observations, results from a physical model of the estuary and results from the standard model. Compared with the standard model, the new computer model gave much better representation of the water levels in the upper estuary and of wetting and drying of the intertidal areas. The results agreed well with the field observations and with the calibrated physical model. (author).

17 WIND ENERGY

46786 (STEV-VIND–90-37) **GAROS input deck description.** Vollan, A. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)); Soederberg, M. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). 1989. 37p. Project STEV-506-266. (FFA-TN–1987-40). Order Number DE90518784. Source: NTIS (US Sales Only), PC A03/MF A01.

This report describes the input for the programs GAROS1 and GAROS2, version 5.8 and later, February 1988. The GAROS system, developed by Arne Vollan, Omega GmbH, is used for the analysis of the mechanical and aeroelastic properties for general rotating systems. It has been specially designed to meet the requirements of aeroelastic stability and dynamic response of horizontal axis wind energy converters. Some of the special characteristics are: * The rotor may have one or more blades. * The blades may be rigidly attached to the hub, or they may be fully articulated. * The full elastic properties of the blades, the hub, the machine house and the tower are taken into account. * With the same basic model, a number of different analyses can be performed: Snap-shot analysis, Floquet method, transient response analysis, frequency response analysis etc.

46787 (STEV-VIND–90-38) **GARFEM input deck description.** Zdunek, A. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)); Soederberg, M. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). 1989. 40p. Project STEV-506-266. (FFA-TN–1987-12). Order Number DE90518785. Source: NTIS (US Sales Only), PC A03/MF A01.

The input card deck for the finite element program GARFEM version 3.2 is described in this manual. The program includes, but is not limited to, capabilities to handle the following problems: * Linear bar and beam element structures, * Geometrically non-linear problems (bar and beam), both static and transient dynamic analysis, * Transient response dynamics from a catalog of time varying external forcing function types or input function tables, * Eigenvalue solution (modes and frequencies), * Multi point constraints (MPC) for the modelling of mechanisms and e.g. rigid links. The MPC definition is used only in the geometrically linearized sense, * Beams with disjunct shear axis and neutral axis, * Beams with rigid offset. An interface exist that connects GARFEM with the program GAROS. GAROS is a program for aeroelastic analysis of rotating structures. Since this interface was developed GARFEM now serves as a preprocessor program in place of NASTRAN which was formerly used. Documentation of the methods applied in GARFEM exists but is so far limited to the capacities in existence before the GAROS interface was developed.

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 46791, 46792

1705 Environmental Aspects

46788 (STEV-VIND–90-43) **Analysis of the invironmental noise situation around a large Swedish prototype wind turbine.** Ljunggren, S. (Aeronautical Research Institute of Sweden, Bromma (SE)). Statens Energiverk, Stockholm (Sweden). 1990. 135p. Project STEV-506-266. (FFA-TN–1988-1). Order Number DE90518770. Source: NTIS (US Sales Only), PC A07/MF A01.

Results from measurements of noise generated by the 2 MW prototype at Naesudden are presented together with corresponding data for natural wind-induced sound. The results are discussed in the light of the possible masking of turbine noise by wind- induced background sound. The frequency spectrum of the aerodynamic noise from a wind turbine is very similar to that of the wind sound. It is thought that the temporal fluctuations of the turbine noise as well as those of the background sound must be an important factor for the masking. The results show that the fluctuations of the turbine noise at short distance downstream the turbine are dominated by a deterministic modulation at the blade passage frequency. This modulation is fairly small however, the peak value of the amplitude is in general less than 1 dB at a distance of 114 m. Random fluctuations become more important with increasing distance, but there are still traces of the deterministic modulation at a distance of 456 m in the downwind direction. Some analyses of the temporal fluctuations of wind-induced background are also presented. (author) (170 figs.).

46789 (STEV-VIND–90-44) **A preliminary study of the marking of wind turbine noise by ambient sound.** Ekstroem, L. (3K Akustikbyraan AB, Sundbyberg (SE)); Ljunggren, S. Statens Energiverk, Stockholm (Sweden); Flygtekniska Foersoeksanstalten, Stockholm (Sweden). 1990. 14p. Project STEV-506-266. (FFA-TN–1990-01). Order Number DE90518771. Source: NTIS (US Sales Only), PC A03/MF A01.

The usual way of assessing environmental noise from large sources outdoors is to compare the immission level with a certain level given by an appropriate authority. Another way, often used in the past, is to compare the noise with the background sound. As wind turbines are working during periods of comparatively high wind, and hence during periods of high background levels, the background sound is attractive. However, it should be remembered that the noise from a wind turbine as well as the background sound caused by the interaction of the wind with trees, buildings etc, do vary in time. Furthermore, the level variations due to some effects are correlated whereas others are not correlated. The work reported here forms a part of a larger project devoted to the assessment of the masking effect on the noise from wind turbines by ambient sound. Previous work within this project has been devoted mainly to the periodic modulation of the wind turbine noise and to analyses of gaps in the wind sound (especially to the presence of gaps in the wind sound where an otherwise masked turbine noise could become audible). In present stage of the work some introductory studies of two new topics have been carried out: 1. Long-time co-variation of the wind speeds at high and low heights above the ground. 2. Co-variation of turbine and background sound for thee hypothetical turbine concepts. (authors).

1706 Wind Energy Engineering

46790 (ECN-C–90-024) **Investigation into the cause of the burn-out of synchronous generators in wind turbines.** Baltus, C.W.A. Netherlands Energy Research Foundation, Petten (Netherlands). May 1990. 158p. (In Dutch). Contract NOVEM 18.73-130.10. Order Number DE90519651. Source: NTIS (US Sales Only), PC A08/MF A01.

Within the framework of the National Development Program Wind Energy, ECN (Netherlands Energy Research Foundation) investigated the title subject in cooperation with the University of Technology in Eindhoven. The report holds seven appendices which are reports in themselves. Possible burn-out causes are listed in appendix 1 as well as already burnt-out synchronous generators which were applicated in wind turbines with variable speed. Based on these data, a proposal is made for a laboratory test program in order to locate the burn-out causes. Specifications for a test facility are presented in appendix 2. The appendices 3 to 7

give the results of temperature measurements, voltage measurements and partial discharge measurements. Partial discharges affect slowly the insulation of windings in the generator. These discharges are caused by moisture or damp with salt particles. Recommendations to avoid this problem concern the application of cooling filters for open machines, heating for closed machines and limiting of the peak loads.

46791 (EUR–12117) **Wind energy for Easterhoull chalets: Demonstration project: Final report.** Saluja, G.S. (Robert Gordon's Inst. of Tech., Aberdeen (UK)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Robert Gordon's Inst. of Tech., Aberdeen (UK). 1989. 79p. Sponsored by Commission of the European Communities. Contract WE/96/83-UK. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50.

This report summarises operating experience and analyses the economics of a small grid connected wind turbine generator. The analysis is based on 33-month performance data from the CEC supported demonstration project at Scalloway in the Shetland Islands of Scotland to provide wind generated electricity to tourist isolated and island communities. A Vestas 55/11 kW, 15 m rotor diameter wind turbine generator was installed in August 1985 and has been operating satisfactorily since then. A user oriented approach has been adopted to calculate the actual cost savings as a direct result of installing the wind turbine. The implications of the special terms for supply of electricity to small private generators by the North of Scotland Hydro Electric Board – the electricity authority in the area – are considered. A comparison is made with various tariff structures operated within the Board's diesel and non-diesel areas for domestic, farm and general consumers. 32 refs., 33 figs., 21 tabs.

46792 (EUR–12171) **Utilization of wind energy in conjunction with a heat pump for greenhouse heating: Demonstration project: Final report.** O'Flaherty, T. (Teagasc, Dublin (Ireland). Kinsealy Research Centre). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Teagasc, Dublin (Ireland). Kinsealy Research Centre. 1989. 56p. Sponsored by Commission of the European Communities. Contract WE/62/83. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 6.25.

This paper describes a demonstration program at the Kinsealy Research Center of Dublin, Ireland. A wind turbine drives a heat pump that heats a greenhouse performance. Data is given for operations from July 1985 to June 1988; conclusions about the project are advanced. 11 figs., 14 tabs. (FSD)

46793 (EUR–12225) **Wind energy for a fish farm in Sicily: Demonstration project.** Bonservizi, F. (Impianti Sfruttamento Energie Alternative, Ponte San Giovanni (Italy)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 32p. Sponsored by Commission of the European Communities. Contract WE/594/84 IT. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

The principal aim of this project was to demonstrate that in a site with a medium wind speed of c. 5.5 m/sec. not fed by the national grid, it is possible to feed constantly consumers with industrial needs, using only electrical or thermal renewable energy produced by wind generators and co-generators. This report describes that project. Three wind-turbines of 42 kVA each have been installed in a fish farm near Marsala (Sicily); one of them operates in parallel with a gas co-generator while the two gas co-generators with the other two WECs are in parallel with a national electric grid. The electricity and the heat are used for the energy needs of the Italittica fish farm. According to the project three horizontal-axis, upwind turbines manufactured by Aeroman-ISEA with a nominal power of 33 kW each and three gas co-generators manufactured by Teledyne-ISEA with a nominal power of 30 kW electric and 40 kW thermal each, were installed and commissioned in two months. During the eight months of the demonstration phase the plant produced 279 280 kWh of electrical energy and 282 960 kWh of thermal energy with an investment cost of LIT 613 million and a saving of LIT 28 million per year; therefore the pay-back period will be 22 years. The cost per energy unit is LIT 61 for the aeolic kWh and LIT 61 for the co-generation kWh. The same plant, but in isolated areas, that is to say not connected to a national electric grid, could cost LIT 450 million with a cost saving of LIT 50 million each year, therefore in this case the pay-back period could be nine years, i.e. the same as the initial appraisal of this project. 23 figs.

46794 (EUR–12232) **Development and construction of a modular system for an autonomous electrical power supply on the Irish island of Cape Clear: Demonstration project: Final report, January 1, 1985–July 31, 1988.** Cramer, G. (SMA System-, Mess- und Anlagentechnik - Regelsysteme GmbH, Niestetal (Germany, F.R.)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; SMA System-, Mess- und Anlagentechnik - Regelsysteme GmbH, Niestetal (Germany, F.R.). 1989. 156p. Sponsored by Commission of the European Communities. Contract WE/306/84. Source: NTIS (US Sales Only), PC A08/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 12.50.

The aim of this demonstration project as described herein, was to develop and build up a modular autonomous electricity supply system, consisting of wind energy converters and diesel generator units. An extremely economic supply of electrical consumers not connected to the public grid should be obtained with a good efficiency and a minimum use of hardware. The installation and the putting into operation was carried out in two steps. First, both WECs and the measured value acquisition units were installed in October 1986. In the first project phase, both WECs were operating in parallel to the existing diesel engines in "fuel-saving" mode. The installation of the battery-converter unit and the diesel engine with disconnectible motor were carried out on August 1987. The evaluation of the recorded data (measurement period of nearly one year) showed the significant advantages of the developed autonomous power supply system compared to conventional diesel plants. About 70% of the total electricity demand on the island was supplied by the WECs of the Wind/Diesel/Battery Combination. The overall running time of the diesel motor is reduced to one third from which a correspondingly loner lifetime results. The economy evaluation resulted in a kWh-price 25% lower than the kWh-price for a diesel plant of comparable size. 7 refs., 93 figs., 7 tabs.

46795 (EUR–12239) **The 1 MW wind turbine at Wieringermeer: Demonstration project: Final report.** Van der Steen, A. (Van der Steen (A.), Bloemendaal (Netherlands)); Overbeek, H. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 103p. Sponsored by Commission of the European Communities. Contract WE/154/83 NL. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 8.75.

The main purpose of the program were: check of occurring loads during start-up; and verification of the predicted load and performance characteristics. Within the scope of this measurement program the following reports (11) to (37) were published. The reports coded with Stork FDO-WES TN-XX-XX, are for internal use only. A review of the measurement system and a discussion of results are presented. Main subjects of this discussion are: P-V curve; annual wind speed distribution; annual production; conversion efficiency; comparison of measured and calculated loads; and fatigue load spectra. Also an extensive review of turbine data, as well as a summary of the theoretical models for predicting structural loads, are given. 50 refs., 55 figs., 10 tabs.

46796 (STEV-VIND–90-20) **Some aspects of wind diesel systems with reference to Chalmers experimental wind diesel system.** Linders, J. (Chalmers Univ. of Tech., Goeteborg (SE). Dept. of Electrical Machines and Power Electronics). Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden).

May 1989. 14p. Project STEV-506-258. (CONF-8905343–1: Workshop on winde/diesel systems, Goeteborg (Sweden), 8-9 May 1989; CTH-R–89-8). Order Number DE90518772. Source: NTIS (US Sales Only), PC A03/MF A01.

The paper presents simple descriptions and control strategies for component parts of wind-diesel systems. Turbine control, generators, convertors and energy storage alternatives are discussed. A brief presentation of Chalmers experimental wind-diesel system is also included. (author) (9 refs., 12 figs.).

46797 (STEV-VIND–90-21) **Fatigue testing of glass fibre reinforced epoxy using the WISPER sequence.** Poppen, M. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)). Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). 1989. 18p. Project STEV-506-266. (FFA-TN–1989-45). Order Number DE90518779. Source: NTIS (US Sales Only), PC A03/MF A01.

In this report spectrum fatigue loading of the glassfibre/epoxy material used in the Maglarp wind turbine blades is discussed. The spectrum that has been used is WISPER, a standardized wind turbine spectrum. Comparison of the spectrum data with the constant amplitude data has been performed. The results indicate that Palmgren-Miner's rule is overly conservative. Damage sums up to the order of 20 were experimentally found. Further on, these sums were found to be dependent on load levels used, which makes the application of Palmgren-Miner calculations questionable for real structural components.

46798 (STEV-VIND–90-22) **The use of rare-earth-metals and disc-designed generators in order to increase the output from the windmill.** Alatalo, M. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics). Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). Oct 1989. 10p. Project STEV-506-258. (CONF-890717–5: EWEC '89: European wind energy conference and exhibition, Glasgow (UK), 10-13 Jul 1989; CTH-R–89-16). Order Number DE90518773. Source: NTIS (US Sales Only), PC A02/MF A01.

The paper presents an electrical system comprising a permanent magnetized synchronous generator, suitable for wind power applications. The generator is designed as a disc and the stator is constructed without ordinary teeth. The generator has good performance in terms of noise, vibrations, efficiency, no cogging, and simplicity to manufacture. The whole system is a simple way to control the mill with variable speed and it has high efficiency. (author).

46799 (STEV-VIND–90-23) **Power control of a fixed-pitch variable-speed horizontal windmill used in a wind-diesel system.** Linders, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics). Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). Sep 1989. 11p. Project STEV-506-258. (CONF-890981–5: Windpower '89, San Francisco, CA (USA), 24-27 Sep 1989; CTH-R–89-19). Order Number DE90518774. Source: NTIS (US Sales Only), PC A03/MF A01.

The paper describes a variable-speed system applied on a wind turbine which is used in an experimental wind-diesel system. Control principles and algorithms for the variable-speed system and results from operation are presented. The results show the turbine start-up, dynamic behaviour, step response etc. A description of the entire wind-diesel system and a few long-term results are also included. The evaluation shows that the system has an appropriate control and saves a rather great amount of fuel. (author).

46800 (STEV-VIND–90-27) **Induction machines with two three-phase windings in convertor applications.** Hylander, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics); von Zweygbergk, S. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). 1989. 9p. Project STEV-506-258. (CONF-8904366–1: MELECON '89: 5th Mediterranean electrotechnical conference, Lisbon (Portugal), 11-13 Apr 1989; CTH-R–89-14). Order Number DE90518775. Source: NTIS (US Sales Only), PC A02/MF A01.

Harmonic currents and torques have been investigated with calculations and measurements on a 11 kW induction machine connected to two transistor convertors. The standard winding in the induction machine has been replaced with a new winding, consisting of two three-phase windings separated 30 electrical degrees. The results from the investigation show that harmonic torques can be reduced. (orig).

46801 (STEV-VIND–90-28) **Electrical system with frequency convertors for variable speed operation of windturbines.** Carlson, Ola (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics); Hylander, J. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). Jul 1989. 10p. Project STEV-506-258. (CONF-890717–6: EWEC '89: European wind energy conference and exhibition, Glasgow (UK), 10-13 Jul 1989; CTH-R–89-12). Order Number DE90518776. Source: NTIS (US Sales Only), PC A02/MF A01.

This paper describes two variable speed ac-drive systems, a synchronous generator with frequency convertor for large speed ranges and a rotor cascade induction generator for small variations of speed. Results obtained with transient state calculations using computer models as well as verifying laboratory tests are presented, in form of currents, torques and efficiency. The synchronous generator system together with a digital control system is operating on a 40 kW windmill, for test purpose. The measurements on the wind turbine shows optimal operation in low wind conditions. (orig).

46802 (STEV-VIND–90-29) **Variable speed ac-generators in wind energy convertors.** Carlson, Ola (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics); Hylander, J. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). Apr 1989. 9p. Project STEV-506-258. (CONF-8904366–2: MELECON '89: 5th Mediterranean electrotechnical conference, Lisbon (Portugal), 11-13 Apr 1989; CTH-R–89-11). Order Number DE90518777. Source: NTIS (US Sales Only), PC A02/MF A01.

This paper describes two variable speed ac-drive systems, a synchronous generator with frequency convertor for large speed ranges and a rotor cascade induction generator for small variations of speed. Results obtained with transient state calculations using computer models as well as verifying laboratory tests are presented, in forms of currents and torques. The synchronous generator system together with a digital control system is operating on a 40 kW windmill, for test purpose. The measurements on the wind turbine shows constant torque during high wind conditions. (orig).

46803 (STEV-VIND–90-31) **Fatigue evaluation of WTS-3 wind turbine blade and retention.** Gustavsson, A.I. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)); Blom, A.F. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). 1987. 40p. Project STEV-506-266. (FFA-TN–1987-81). Order Number DE90518780. Source: NTIS (US Sales Only), PC A03/MF A01.

An independent fatigue evaluation of the WTS-3 wind turbine blade and retention is presented. For the blades a comparison of computed stress levels to existing material properties is made and potentially fatigue critical areas are identified. A finite element analysis of the retention adhesive joint is carried out and mean stress levels are compared to design data. Singular stresses at the end of the joint may promote debonding. Hence, this area is being particularly important to access with NDT-techniques. (14 refs., 10 figs., 4 tabs.).

46804 (STEV-VIND–90-32) **Some preliminary results from airborne meteorological measurements in a coastal region in Blekinge 1989.** Tjernstroem, M. (Uppsala Univ. (SE). Dept. of Meteorology). Statens Energiverk, Stockholm (Sweden). 1990. 33p. Project STEV-506-226. Order Number DE90518781. Source: NTIS (US Sales Only), PC A03/MF A01.

Some tentative results from airborne measurements in a coastal zone in the south-east of Sweden are presented. Four cases are shown. Of these, two represent cases showing the influence of the proximity of the land surface on the coastal marine boundary layer,

one shows an example of horizontal inhomogeneity in an presumedly undisturbed marine boundary layer and one case shows an example of a sea-breeze circulation shortly after its initiation. The presented cases are examples of atmospheric flow situations that would have been difficult, if not impossible, to study with a fix point measurement technique. (author) (With 21 figs.).

46805 (STEV-VIND–90-33) **A kite or ballon borne sonde system for wind speed and turbulence measurements, with some wind energy applications.** Smedman, A.S. (Uppsala Univ. (SE). Dept. of Meteorology); Lundin, K.; Bergstroem, H.; Hoegstroem, U. Statens Energiverk, Stockholm (Sweden). 1990. 41p. Project STEV-506-226. Order Number DE90518782. Source: NTIS (US Sales Only), PC A03/MF A01.

A light weight (50g) wind sonde has been developed that can easily be lifted to and operated up to heights around 150 m by a small kite or a small kytoon. Wind is measured by a three cup anemometer and the signal is transmitted by radio to a portable receiver. The sonde has been tested in a wind tunnel as well as against tower-mounted instruments in the field. When mounted on a tower sonde measured wind speed and standard deviation agreed better than ±3% with other, well calibrated tower mounted instruments. When flown under a kite the sonde underestimated the wind speed by 3% and the standard deviation by 2% compared with tower mounted instruments at the same height. The sonde system should prove useful in any meteorological field experiment where detailed information of the three dimensional wind field near the ground is sought. This is the case in many wind energy surveys, and two examples of such studies are given. In the first modification of the local flow field by combination of increased roughness and flow over hill at a coastal site is examined by a combination of tower mounted instrumentation at one site and sonde measurements at two nearby sites. The other study investigated the wake behind the 78 m diameter, 3 MW wind turbine at Maglarp, Sweden, using one kite in the core of the wake and another at the same height but outside the wake. Mean velocity deficit and turbulence data were obtained at several distances between 2 and 10 diameters downwind of the turbine. Comparisons with wake data, obtained with other techniques, support the results of the sonde data. (authors) (18 refs., 17 figs.).

46806 (STEV-VIND–90-34) **Evaluation of an autonomous wind-diesel system with a dynamic battery storage.** Linders, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics). Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electical Machines and Power Electronics; Statens Energiverk, Stockholm (Sweden). Jul 1989. 10p. Project STEV-506-258. (CONF-890717–7: EWEC '89: European wind energy conference and exhibition, Glasgow (UK), 10-13 Jul 1989; CTH-R–89-18). Order Number DE90518778. Source: NTIS (US Sales Only), PC A02/MF A01.

The paper presents results from measurements on dynamic performance at Chalmers experimental wind-diesel system. Results and descriptions of control algorithms for the energy storage system, the autonomous grid, the diesel generator and the wind turbine system are included. A short system description is also given. The measurements mainly describe the system behavior at wind fluctuations and at load changes.

46807 (STEV-VIND–90-36) **Wind power plant Gothenburg: Final report.** Sandberg, O. (3K Engineering AB, Stockholm (SE)). Statens Energiverk, Stockholm (Sweden). Dec 1989. 39p. (In Swedish). Project STEV-506-275. Order Number DE90518783. Source: NTIS (US Sales Only), PC A03/MF A01.

This report, that was financed by Statens Energiverk, is an extension to the study of a medium sized WECS carried out by 3K Engineering for Vattenfall, Statens Energiverk and VAST. It consist of detailed analyses that were done in preparation of a detailed design of the windmill. Chapter 3 deals with noise. A recent report suggests that the noise level of a WECS at a specified distance should not exceed the level of background noise. Since the most severe part of a windmill noise is due to blade tip noise, this approach favours variable speed windmills Maximum blade tip speed of a windmill that does not exceed background noise at a distance of 200 meters was determined to be 97 m/s. Chapter 4 deals with the optimal rotor size of the windmill at a given site. Costs and revenues were analysed. Limitations in rotor size due to tower natural frequencies and noise were considered. An optimal diameter od around 45 meters was chosen based on a marginal cost/revenue consideration. In chapter 5 blade profiles suitable for a yaw control WECS were studied. A blade profile showing favourable stalling features was chosen. In chapter 6 causes of large teeter motions during the stopping procedure at yawed position was analysed. The main cause for these motions seems to be wind shear across the rotor. This cannot easily be controlled in the design without the introduction of a teeter damper. Different types of dampers are analysed. A teeter brake is found to have the best effect. A design of such a brake is also presented. (author) (11 refs., 13 figs., 4 tabs.).

46808 (STEV-VIND–90-39) **Implementation of shear offset and rigid offset in finite element code GARFEM.** Soederberg, M. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)). Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). 1989. 67p. Project STEV-506-266. (FFA-TN–1989-24). Order Number DE90518786. Source: NTIS (US Sales Only), PC A04/MF A01.

The finite element code GARFEM is used at FFA mainly to make structural analyses of wind turbine structures. This report concerns a modification of the code to handle a more refined beam element. The new beam element can take care of separate neutral axis and shear axis, and also rigid offset of the beam element. The two possibilities are independent of each other and can be combined freely. The theory for both improvements of the beam element is presented. This report documents the changes from GARFEM version 3.1 (87-04-08) to GARFEM version 3.2 (89-04-14).

46809 (STEV-VIND–90-41) **Harmonic currents and torque pulsations with pulse width modulation methods in AC motor drives.** Nystroem, Aa. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Electrical Machines and Power Electronics); Hylander, J.; Thorborg, K. Statens Energiverk, Stockholm (Sweden). 1990. 9p. Project STEV-506-258. Order Number DE90518769. Source: NTIS (US Sales Only), PC A02/MF A01.

The pulse width modulation (PWM) method used in ac motor drives influences the harmonic current content and torque pulsations. To investigate this, two PWM methods are compared by means of computer calculations and measurement on an 11 kW squirrel-caged induction motor fed by a transistor inverter.

46810 **A model of the 34m VAWT variable speed generator control system.** Ralph, M.E. (Wind Energy Research Div., Sandia National Lab., Albuquerque, NM (US)). pp. 189-190 of Proceedings of the ninth ASME wind energy symposium: SED-Volume 9. American Society of Mechanical Engineers, New York, NY (USA) (1990). DOE Contract AC04-76DP00789. (CONF-900102–: 13. energy-sources technology conference and exhibition, New Orleans, LA (USA), 14-18 Jan 1990).

Sandia National Laboratories has designed and built a 34-metre vertical-axis wind turbine. The 500 kW turbine has a variable-speed constant-frequency (VSCF) generator which controls the speed of the turbine from 6 to 40 rpm. Testing of the turbine has been under way for over a year. When the turbine is operated in higher winds, the turbine's speed has been found to vary by up to 2 rpm from the set point speed. These speed variations have also shown up as fluctuations in the output power. The actual turbine's speed response while operating in a fixed speed mode at 31 rpm in an 8.5 mps wind is shown. These speed and power fluctuations are undesirable from both a testing and operational standpoint. This paper discusses the work directed towards understanding and correcting the problem.

1707 Health and Safety

46811 (ECN-C–90-021) **Wind turbine type WHP-15-3-25 tests at the ECN wind turbine test station.** Van der Borg, N.J.C.M.; De Vries, P. Netherlands Energy Research Foundation, Petten (Netherlands). May 1990. 19p. Order Number DE90519649. Source: NTIS (US Sales Only), PC A03/MF A01.

Five wind turbines of the type WHP-15-3-25 built by Wind Power Holland Ltd. have been erected on a site in India. The turbines failed after commissioning due to mechanical instabilities which caused severe damage to the turbines. The manufacturer claims that he has investigated and solved the problems by improving the design. In order to verify whether the improvements are adequate and to provide a higher level of confidence in the operation of the machine it was considered necessary to test one specimen of an improved type at the test station at Petten. The scheduled test program could not be completed due to contracting problems and storm damage. All the objectives of the test were therefore not completed. Instead a thorough analysis of the incident was performed. It is concluded that the turbine is un-safe. A complete test program of a prototype is required before a specimen of the turbine type can be used for commercial applications. 8 figs., 2 apps.

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Refer also to citation(s) 46390, 46392, 46793, 46844, 46940, 46948, 46949

46812 (EPRI-GS–6913) **Feedwater heaters: Replacement specification guidelines: Final report.** Wadsworth, F.L. (Sonalysts, Inc., Waterford, CT (USA)); Catapano, M.C. Electric Power Research Inst., Palo Alto, CA (USA); Sonalysts, Inc., Waterford, CT (USA); Powerfect, Inc., Livingston, NJ (USA). ©Aug 1990. 159p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report provides guidance and background material for utilities to assist them in developing improved specifications for procurement of replacement feedwater heaters. State-of-the-art recommendations and examples are described based upon recent developments in selected specifications actually used by utilities with aggressive feedwater heater maintenance programs. A significant portion of the guidelines are presented in typical specification format and wording, with explanatory notes. The report also stresses the shortcomings of the procurement processes which have been identified as root causes of poor quality and premature failures of feedwater heaters. Specific recommendations are offered for utility management to initiate remedial actions, working with suppliers and regulators to resolve this problem. Until the procurement system is improved, utilities will need comprehensive, detailed procurement specifications. 1 fig.

46813 (EPRI-GS–6935) **Feedwater heaters maintenance and repair technology: Reducing outage cost: Final report.** Wadsworth, F.L. (Sonalysts, Inc., Waterford, CT (USA)); Catapano, M.C. Electric Power Research Inst., Palo Alto, CA (USA); Sonalysts, Inc., Waterford, CT (USA); Powerfect, Inc., Livingston, NJ (USA). ©Aug 1990. 238p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report is an assessment of the current state-of-the-art technology and techniques in the maintenance and repair of feedwater heaters. It is based upon a review of current practices in the United States utility industry. Selected techniques in use in Europe, Canada and Australia were also considered where they were considered pertinent to closed feedwater heaters with tubsheet designs. The study focused on those maintenance activities, procedures, and equipment that offer the most opportunity for improving plant performance and availability and reducing plant costs. The report provides detailed guidance for some of the critical maintenance activities performed by utility personnel such as visual inspections, leak detection and location, tube plugging, failure analyses, and selected repairs. It also includes helpful advice on the use of testing equipment and maintenance support often provided by service contractors. Summaries of some of the most promising newer systems of NDE are also included, along with practical comments on their benefits and limitations (e.g., sonic pulse testing, ultrasonic testing of tubes, remote field, and magnetic flux leakage systems). The report emphasizes the need for management to institute policy and procedural improvements in order to benefit from the technologies now available. 56 refs., 83 figs., 5 tabs.

46814 (EPRI-GS–6961-Vol.1) **Control upgrade study for Huntley Unit 65: Volume 1, Executive summary: Final report.** Willsey, P.T. (Niagara Mohawk Power Corp., Syracuse, NY (USA)); Lassahn, P.L.; Brown, B.B.; House, W.E.; Fray, R.R.; Knobel, P.; Labbe, D.E. Electric Power Research Inst., Palo Alto, CA (USA); Niagara Mohawk Power Corp., Syracuse, NY (USA); Science Applications International Corp., Idaho Falls, ID (USA); Stone and Webster Engineering Corp., Boston, MA (USA). ©Aug 1990. 26p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report summarizes a reliability, availability, and maintainability (RAM) analysis and an advanced control study conducted to support the Control Upgrade Project. The RAM analysis and advanced control study were conducted to determine the potential benefits of upgrading the Huntley Unit 65 control system, to transfer technology, and to identify the main contributors to plant unavailability. The RAM analysis used CAFTA software and was supplemented with a human factors evaluation. The advanced control study explored several traditional and advanced control strategies using the code Modular Modeling System (MMS) and incorporated a set of "cost functions" to provide comparison of the alternative strategies. The RAM analysis identified the main mechanical contributions to unavailability and showed that RAM analyses could be a tool for both plant operators and corporate managers to improve availability, prioritize expenditures, and improve maintenance. The model has been updated, and the database for the RAM analysis now contains eight years of data. 1 ref., 1 fig., 3 tabs.

46815 (EPRI-GS–6961-Vol.2) **Control upgrade study for Huntley Unit 65: Volume 2, Reliability, availability, and maintainability analysis: Final report.** Barber, S.H. (Niagara Mohawk Power Corp., Syracuse, NY (USA)); Colasanti, R.; Marko, R.; Lassahn, P.L.; Brown, B.B.; House, W.E.; Rumble, E.T. III; Koren, J.M.; Grote, T.A.; Fray, R.R. Electric Power Research Inst., Palo Alto, CA (USA); Niagara Mohawk Power Corp., Syracuse, NY (USA); Science Applications International Corp., Idaho Falls, ID (USA). ©Aug 1990. 378p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes a reliability, availability, and maintainability (RAM) analysis conducted to support the Control Upgrade Project. The study's principal objective was to determine the potential benefits of upgrading the Huntley Unit 65 control system. Other study objectives included technology transfer and the identification of the main contributors to plant unavailability. The project used CAFTA software to model the plant. The RAM analysis was supplemented with a human factors evaluation. 15 refs., 20 figs., 7 tabs.

46816 (EPRI-GS–6961-Vol.3) **Control upgrade study for Huntley unit 65: Volume 3, Controls analysis: Final report.** Kulczycky, T.G. (Niagara Mohawk Power Corp., Syracuse, NY (USA)); Donohue, J.M.; Fox, J.C.; Knobel, P.; Labbe, D.E.; Taber, B.D. Electric Power Research Inst., Palo Alto, CA (USA); Niagara Mohawk Power Corp., Syracuse, NY (USA); Stone and Webster Engineering Corp., Boston, MA (USA). ©Aug 1990. 97p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

A series of studies to evaluate potential improvements in Niagara Mohawk Power Corporation's (NMPC's) Huntley units 65/66 plant control system configuration and to quantify the value of these improvements is described. A dynamic simulation model of the plant is used as a test bed to explore alternative traditional and advanced control schemes. A set of "cost functions" is described and incorporated into simulation models to provide objective comparison of alternative control techniques. Constant pressure operating modes and sliding pressure operating modes, are evaluated. The study focuses on two advanced control schemes: gain scheduling, a form of adaptive control, and model reference feed forward, in which a portion of the simulation model is embedded into a modern distributed control system (DCS). When combined, these

techniques offer extremely precise control, minimized life expenditure, and improved maneuvering ability of the plant. Guidelines for installation of the advanced control algorithms on a DCS are presented. 14 refs., 36 figs., 3 tabs.

46817 (NEI-FI–122) **Economic development of domestic fuel plants during the period of 1985-1986.** Nikula, S.L.; Seppaelae, R. Ekono, Helsinki (Finland). 1989. 49p. (In Finnish). Project KTM-323/881/87. Order Number DE90518737. Source: NTIS (US Sales Only), PC A03/MF A01.

The study covered 66 plants using domestic fuels, half of which weere limited liability companies and the other half were munipipal plants. For peat-fired power plants organized as limited liality companies the operating profit median values were about 30% whereas the same values for municipal plants were about 40%. The operating profit of chip-fired power plants was about ten percentage points below the operating profit of peat power plants on the average. The median values of return on total assests % were 2.1...-1.1% for peat power plants and -1.5...-5.8% on the average for chip-fired power plants. The profitability of small plants with thermal power sales less than 40 GWh/a was especially low. Peat power plants organized as limited liability companies and with thermal power sales exceeding 40 GWh/a already reached a moderate gain of 3-5 per cent. The current ratio was calculated only for plants organized as limited liability companies. The average current ratio value was 1.3-1.5 for peat power plants and 1.0-1.3 for chip power plant. In view of the characteristics, the liquidity of the plants can be regarded as satisfactory. The solidity % was calculated only for plants organized as limited liability companies. The solidity 5 was 27-31 per cent for peat power plants and 11-19 per cent for chip power plants. In view of the characteristics, the solidity of peat power plants can be regarded as satisfactory. The solidity of chip power plants must be regarded as not more than passable.

46818 (PNL-SA–17992) **Thermal energy storage for power generation applications.** Drost, M.K.; Antoniak, Z.I.; Brown, D.R. Pacific Northwest Lab., Richland, WA (USA). Mar 1990. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-9004133–4: American power conference, Chicago, IL (USA), 23-25 Apr 1990). Order Number DE90016539. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Studies strongly indicate that the United States will face widespread electrical power constraints in the 1990s. In many cases, the demand for increased power will occur during peak and intermediate demand periods. While natural gas is currently plentiful and economically attractive for meeting peak and intermediate loads, the development of a coal-fired peaking option would give utilities insurance against unexpected supply shortages or cost increases. This paper discusses a conceptual evaluation of using thermal energy storage (TES) to improve the economics of coal-fired peak and intermediate load power generation. The use of TES can substantially improve the economic attractiveness of meeting peak and intermediate loads with coal-fired power generation. In this case, conventional pulverized coal combustion equipment is continuously operated to heat molten nitrate salt, which is then stored. During peak demand periods, hot salt is withdrawn from storage and used to generate steam for a Rankine steam power cycle. This allows the coal-fired salt heater to be approximately one-third the size of a coal-fired boiler in a conventional cycling plant. The general impact is to decouple the generation of thermal energy from its conversion to electricity. The present study compares a conventional cycling pulverized coal-fired power plant to a pulverized coal-fired plant using nitrate salt TES. The study demonstrates that a coal-fired salt heater is technically feasible and should be less expensive than a similar coal-fired boiler. The results show the use of nitrate salt TES reduced the levelized cost of power by between 5% and 24%, depending on the operating schedule. 9 refs., 1 fig., 3 tabs.

2002 Waste Management

Refer also to citation(s) 46387, 46393, 46396, 46948, 47069

46819 (DOE/FE–0198P) **Comprehensive report to Congress Clean Coal Technology Program: 10 MW demonstration of gas suspension absorption.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Jul 1990. 32p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90016669. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In September 1988, Congress provided $575 million to conduct cost- shared Clean Coal Technology (CCT) projects to demonstrate technologies that are capable of retrofitting or repowering existing facilities. The AirPol, Inc. project will demonstrate the Gas Suspension Absorption (GSA) process. This process uses a unique absorber in which the flue gas is contacted with lime to remove up to 90% of the sulfur dioxide (SO_2) in the flue gas at a low calcium to sulfur stoichiometric ratio. The heart of the process is the GSA reactor. The flue gas flows upward through the vertical reactor vessel located between the air preheater and the particulate removal equipment. Fresh lime is injected as a slurry through a nozzle located in the base of the reactor. The quantity of fresh lime used is based on the SO_2 content of the gas and the amount of water is controlled to cool the gas to the desired approach to its saturation temperature. Dry, partially spent lime is desired approach to its saturation temperature. Dry, partially spent lime is collected by a cyclone located downstream of the reactor and recycled back to the absorber. The gas then passes through an electrostatic precipitator (ESP) where the balance of the sorbent and fly ash are removed and the clean flue gas exits the plant through the stack. The project is located at the Shawnee Test Facility which is part of the Shawnee Fossil Plant in West Paducah, Kentucky. 5 figs., 1 tab.

46820 (DOE/PC/88874–T9) **Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 8, April 1, 1990 through June 30, 1990.** Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.; Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering. 27 Jul 1990. 113p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88874. Order Number DE90016794. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Research continued on mass transfer effects in in-duct flue gas desulfurization. During this reporting period, bench- and pilot-scale experiments have been conducted to measure mass transfer and kinetics rates under simulated duct injection conditions. Section 2 describes the stirred tank reactor test results. Currently, efforts are being placed on determining which assumptions or input to the model are responsible for the model's over-prediction of results by a factor of 2. Section 3 presents the results of experiments investigating slaking modifications. Two surface active additives – methyl alcohol and calcium lignosulfonate – were tested with the hope of decreasing median particle size of slaked Ca(OH)2. Section 4 summarizes the status of short time differential reactor experiments with moist solids. Higher conversions were measured for sorbents with increased level of initial free moisture than for dry $Ca(OH)_2$. Section 5 reports on investigation of agglomeration of damp $Ca(OH)_2$-based solids. Agglomeration of $Ca(OH)_2$ solids was found to increase as moisture content increased. 13 figs., 3 tabs.

46821 (EPRI-GS–6930) **Investigation of flue gas desulfurization chemical process problems.** Electric Power Research Inst., Palo Alto, CA (USA); Radian Corp., Austin, TX (USA). ©Aug 1990. 353p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report documents the results of investigations of various chemical-related problems with lime/limestone FGD systems. These problems include inadequate SO_2 removal, chemical scale formation within the FGD system, sludge dewatering, FGD system water management, process control, and a collection of other problems which affect the operability and reliability of the FGD system. In general, most of the investigations contain a description of the problem at a particular FGD system; a description of the plant, FGD system, and major equipment; results of the chemical characterization of the FGD system; identification of the causes of the problem and recommendations to improve FGD system performance; and performance data on the system after the changes were made. In certain cases, the economic benefits from eliminating or reducing the severity of a particular problem are presented. A

section on the improvement in the solid waste characteristics from a lime dual alkali FGD system is also included. 142 figs., 46 tabs.

46822 (PB–90-250168/XAB) **Accuracy and reliability of CEMS at subpart DA (electric utilities) facilities.** Walsh, G.; Mans, K. Entropy Environmentalists, Inc., Research Triangle Park, NC (USA). Mar 1990. 59p. Contract EPA-68-02-4550. Source: NTIS, PC A04/MF A01.

EPA promulgated minimum quality assurance (QA) requirements for Continuous Emission Monitoring Systems (CEMS) in 40 CFR Part 60 Appendix F. Appendix F requires Da source owners to develop site-specific QA plans and report the results of EPA specified QA activities each calendar quarter. The first calendar quarter for which a report was to be submitted is January through March 1988. The report of QA activities under Appendix F is called a Data Assessment Report (DAR). The DAR includes identifying and descriptive information for the CEMS, results of periodic audits, identification of periods when calibration drift exceeds specific criteria, identification of periods when the analyzers of CEMS are out of control (OOC), and descriptions of corrective actions in response to OOC conditions. An OOC period occurs when an analyzer or a CEMS fails to meet criteria specified in Appendix F. The criteria are expressed in terms of CEMS relative accuracy, analyzer accuracy, and analyzer drift. The principle objective of the study is an evaluation of the information in DARs for six quarters from January 1988 through June 1989. Secondary study objectives include the establishment of contacts with agency staff who normally receive the DARs each quarter and identification of facilities for which DARs were apparently not received, for follow-up by the appropriate agency.

2005 Environmental Aspects

Refer also to citation(s) 46392

2007 Legislation and Regulations

Refer also to citation(s) 46822

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 46927

46823 (IAEA-TECDOC–540) **Safety aspects of nuclear power plant ageing.** International Atomic Energy Agency, Vienna (Austria). Jan 1990. 200p. Order Number DE90638397. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

The nuclear community is facing new challenges as commercial nuclear power plants (NPPs) of the first generation get older. At present, some of the plants are approaching or have even exceeded the end of their nominal design life. Experience with fossil fired power plants and in other industries shows that reliability of NPP components, and consequently general plant safety and reliability, may decline in the middle and later years of plant life. Thus, the task of maintaining operational safety and reliability during the entire plant life and especially, in its later years, is of growing importance. Recognizing the potential impact of ageing on plant safety, the IAEA convened a Working Group in 1985 to draft a report to stimulate relevant activities in the Member States. This report provided the basis for the preparation of the present document, which included a review in 1986 by a Technical Committee and the incorporation of relevant results presented at the 1987 IAEA Symposium on the Safety Aspects of the Ageing and Maintenance of NPPs and in available literature. The purpose of the present document is to increase awareness and understanding of the potential impact of ageing on plant safety; of ageing processes; and of the approach and actions needed to manage the ageing of NPP components effectively. Despite the continuing growth in knowledge on the subject during the preparation of this report it nevertheless contains much that will be of interest to a wide technical and managerial audience. Furthermore, more specific technical publications on the evaluation and management of NPP ageing and service life are being developed under the Agency's programme, which is based on the recommendations of its 1988 Advisory Group on NPP ageing. Refs, figs and tabs.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 46833, 46854, 46871, 46875, 46878, 46882, 46883, 46884, 46885, 46887, 46888, 46889, 46890, 47378, 47698

46824 (CNIC–00287) **Simulation experiments of small break LOCA in upper plenum joint pipe for 5 MW heating test reactor.** Bo Jinhai (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Jiang Shengyao; Zhang Youjie; Tong Yunxian; Sun Shusen; Yao Meisheng. China Nuclear Information Centre, Beijing, BJ (China). Dec 1988. 15p. (In Chinese). (TSHUNE–0007). Order Number DE90638407. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A simulation experiment of small break LOCA is introduced, which was caused by the breakdown of a small size or middle size pipe located at upper plenum, or by unexpected opening the safety valve. In the tests, the system pressure, temperature, void fraction and total loss of water were studied. The results showed that the total loss of water was nearly 20% of initial loading water. It means under this condition the 5MW low temperature heating reactor being built in Institute of Nnclear Engergy Technology of Tsinghua University is safe.

46825 (CONF-900814–12) **Power Reactor Embrittlement Data Base.** Kam, F.B.K.; Stallmann, F.W.; Wang, J.A. Oak Ridge National Lab., TN (USA). [1990]. 11p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90017016. Source: NTIS, PC A03/MF A01; OSTI; INIS.

Regulatory and research evaluations of embrittlement predication models and of pressure vessel integrity can be greatly expedited by the use of a well-designed, computerized data base. The Power Reactor Embrittlement Data Base (PR-EDB) is such a comprehensive collection of data for US commercial nuclear reactors. The Nuclear Regulatory Commission (NRC) has provided financial support, and the Electric Power Research Institute (EPRI) has provided technical assistance in the quality assurance (QA) of the data to establish an industry-wide data base that will be maintained and updated on a long-term basis. Successful applications of the data base to several of NRC's evaluations have received favorable response and support for its continuation. The future direction of the data base has been designed to include the test reactor and other types of data of interest to the regulators and the researchers. 1 ref.

46826 (NUREG/CR–4744-Vol.3-No.2) **Long-term embrittlement of cast duplex stainless steels in LWR systems: Semiannual report, April–September 1988: Volume 3, No. 2.** Chopra, O.K. (Argonne National Lab., IL (USA)); Chung, H.M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA). Aug 1990. 48p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. (ANL–90/5-Vol.3-No.2). Source: NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

This progress report summarizes work performed by Argonne National Laboratory on long-term embrittlement of cast duplex stainless steels in LWR systems during the six months from April to September 1988. Characteristics of the primary mechanism of aging embrittlement (i.e., spinodal decomposition of ferrite) and synergistic effects of alloying and impurity elements that influence the kinetics of the primary mechanism are discussed. Several secondary metallurgical processes of embrittlement, strongly dependent on the C, N, Ni, Mo, and Si content of various heats, are identified. Information on kinetics and data on impact properties are analyzed and correlated with microstructural characteristics to provide a unified method of extrapolating accelerated-aging data to reactor operating conditions. Fracture toughness data are

presented for several heats of cast stainless steel aged at temperatures between 320 and 450 °C for times up to 10,000 h. Mechanical property data are analyzed to develop the procedure and correlations or predicting the kinetics and extent of embrittlement of reactor components from known material parameters. The method and examples of estimating the impact strength and fracture toughness of cast components during reactor service are described. The lower-bound values of impact strength and fracture toughness for cast stainless steels at LWR operating temperatures are defined. 42 refs., 14 figs., 6 tabs.

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 46825, 46826, 46854, 46870, 46875, 46878, 46879, 46882, 46883, 46884, 46885, 46886, 46887, 46888, 46889, 46890, 47386

46827 (CDTN-DERL-PD–001/83) **Analysis of discharge designs and required distance from outfall to intake for the Iguape Nuclear Power Station, Units 1 and 2.** Moreira, R.M. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Jan 1983. 157p. Order Number DE90640012. Source: NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

The analysis of discharge designs and required distance from outfall to intake for the Iguape Nuclear Power Station, units 1 and 2, three basic designs were considered: an offshore single-port discharge through a surface canal; an offshore single-port discharge through a submerged conduit; and an offshore multiple - port discharge throgh one or more submerged conduits. Are also described the environmental conditions survey, the mathematical analysis, the compute codes and the results obtained. (C.M.).

46828 (CNIC–00290) **Experiments on the spray nozzles used in the pressurizer of power reactor.** Diao Wentang (Research Inst. of Nuclear Power Operation, Wuhan, HB (China)). China Nuclear Information Centre, Beijing, BJ (China). Apr 1989. 13p. (In Chinese). (RINPO–0006). Order Number DE90638426. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The spray nozzle, which is used in the pressurizer of pressurized water reactor system, usually uses a less differential pressure between the reactor inlet and outlet as the spray drive pressure, but its flow rate is relatively larger. It is difficult to obtain a optimum spray performance of such a nozzle. The experimental results of five types of twenty seven spray nozzles in different structures and sizes with the range of the spray drive pressure from 0.127 to 0.245 MPa and the flow rates from 5 to 50 t/h are given. The main factors affecting spray performances and their distribution characteristics have been found. And some relatively suitable spray structures have been recommended, which can be used as references for improving the spray nozzles used in the pressurizers of existing PWRs or of the PWRs to be built.

46829 (CNIC–00296) **Study and analysis for the flow-induced vibration of the core barrel of a PWR.** Yao Weida (Shanghai Nuclear Engineering Research and Development Inst., SH (China)); Shi Guolin; Jiang Nanyan. China Nuclear Information Centre, Beijing, BJ (China). Jan 1989. 13p. (In Chinese). (NERDI–0011). Order Number DE90638427. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The resemblance criteria are derived and a test model is designed by applying the flow-soild coupling theory. After having completed the model analysis of the pressurized water reactor (PWR) core barrel in an 1:10 model, the dynamic characteristics are obtained. In an 1:5 reactor model with a hydraulic closed loop, the hydraulic vibration tests of the core barrel are performed, and the relations between the flow rate and the flow-induced pulse pressure on core barrel, acceleration and strain signals have been measured. The corresponding responses and a group of computational equations for hydraulic vibration are derived from these two experiments. The computational hydraulic vibration responses for core barrel in Qinshan Nuclear Power Plant are in good agreement with the test results, and it shows that the core barrel is safe within its lifetime of 30 years.

46830 (CNIC–00299) **Feedwater automatic-control system for steam generators.** Huang Dongbao (Research Inst. of Nuclear Power Operation, Wuhan, HB (China)); Lin Jie. China Nuclear Information Centre, Beijing, BJ (China). 1989. 20p. (In Chinese). (RINPO–0007). Order Number DE90638428. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A new differential pressure method for measuring the water level in steam generator of PWR is introduced, and the stability and setting parameters of a three-element feedwater control system are analysed in detail. The functions and features of a DDC series-cascaded feedwater control system are also briefly introduced. With the new differential pressure method, the measuring accuracy is as high as 2%. With the flow-preponderated mode, the three-element feedwater controller is able to compensate the 'swell-and-shrink' effects of the water level when load changes, and so the expected transient response for the level can be achieved. By adopting the DDC series-cascaded control, the monitoring function and operation reliability of the control system are enhanced.

46831 (EPRI-NP–6938-D) **PWR primary system chemistry: Experience with elevated pH at Millstone Point Unit 3: Progress report No. 1.** Bergmann, C.A. (Westinghouse Electric Corp., Monroeville, PA (USA)); McAtee, K.R.; Roesmer, J. Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Monroeville, PA (USA). ©Aug 1990. 124p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

The maintenance of an elevated pH of the hot reactor coolant in several plants for a fraction of their respective fuel cycles confirmed earlier laboratory findings that an elevated pH (>6.9 at temperature) resulted in reduced component radiation fields. In view of the potential radiological benefits of elevated coolant pH operation, Northeast Utilities (NU) in support of an EPRI- Westinghouse program, agreed to operate the Millstone 3 plants as a demonstration of elevated coolant pH during operation with extended fuel cycles. This report represents the data and describes the effects of operation of the Millstone 3 cycle 2 core at an elevated hot coolant pH of 7.0–7.5 on Zircaloy cladding corrosion, and on the buildup of core crud and excore radiation fields. The following preliminary conclusion were made based on an evaluation of the data obtained after one cycle of Millstone 3 elevated coolant pH operation. Although some of the measured zirconium dioxide thicknesses are greater than expected, the data does not indicate a significant lithium effect on the corrosion rate of the fuel cladding because of the relatively high variability of thickness measurements on rods of similar duty. There was no observable effect of the higher pH operation on any of the other fuel assembly components. Changes in core crude deposit thickness, chemical and radiochemical composition and apparent residence time were noted. These changes are consistent with the expected effects of a more dissolving coolant on activity and crud transport in a primary circuit. The overall radiation exposure rate trends from cycle 1 to cycle 2 indicated a favorable effect of the higher pH operation. 17 figs., 11 tabs.

46832 (EPRI-NP–6945) **Oxygen control in makeup water for PWRs: Final report.** Silaghy, F. (Burns and Roe, Inc., Oradell, NJ (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Burns and Roe, Inc., Oradell, NJ (USA). ©Aug 1990. 114p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This study describes the oxygen control program and improvements to the make-up water system components of PWR nuclear plants with the ultimate goal of reducing corrosion related problems in the steam generators and other secondary system components. A PWR plant that has a vacuum degasifier has been selected to establish the basis for the program. Following the investigation of the make-up water system components, the report presents instrumentation developed for the program. Recommendations are provided for improvements to the various make-up water system components to lower the dissolved oxygen levels. 5 refs., 23 figs., 3 tabs.

46833 (IAEA-TECDOC–541, pp. 203-226) **Design requirements and reactor designs.** Pedersen, T. (ABB Atom AB, Vaesteraas (Sweden)). International Atomic Energy Agency, Vienna

(Austria). Feb 1990. (CONF-8812147–: Technical committee meeting and workshop on design requirements for the application of advanced concepts in developing countries, Vienna (Austria), 6-9 Dec 1988). In *The role of advanced nuclear power technologies in developing countries: Criteria and design requirements: Proceedings of two technical committee meetings and workshops held in Vienna, 27-30 June 1988 and 6-9 December 1988.* Order Number DE90637324. Source: NTIS (US Sales Only), PC A15/MF A01; OSTI; INIS.

Design requirements fall into three categories. The first comprises the requirements set forth by the regulatory bodies, and forms a mandatory formal base level that must be complied with. The second encompasses requirements that originate from the utilities and potential plant owners/operators, and these normally represent more detailed and practical viewpoints to be used as design goals. The third and last category consists of requirements generated by the designers in order to ensure that the results of the detailed design work will meet the requirements of the two first categories. Examples on such designers' requirements are practical rules for general layout arrangement, installation of components, physical separation of redundant safety-related equipment, radiation protection and selection of materials. If these design requirements could be fixed once and for all, life would be easy for the reactor designer, but this is not the case. The established reactor concepts are steadily challenged by more stringent and supplementary requirements, a shift in emphasis from mitigation to prevention and protection and calls for simplification and cost reductions, and so it is necessary to develop new, advanced reactor concepts. For these reasons, ABB Atom is developing advanced reactor concepts, along two different lines: a new generation of its BWR concept, the BWR 90, and a PWR type of reactors, the PIUS/SECURE family. The latter comprises two basic versions the SECURE reactor for generation of heat only (at about 150 deg. C), and the PIUS reactor for generation of electricity or for cogeneration of heat and electricity. The paper discusses some important current design requirements and some trends, under discussion in industrialized countries, that would have significance also for developing countries. Design features of the ABB Atom advanced reactor concepts are also presented and discussed. (author). 11 figs.

46834 (IPEN-PUB–186) **Pressurized water reactor fuel rod design methodology.** Silva, A.T.; Esteves, A.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 10p. (In Portuguese). Order Number DE90640013. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The fuel performance program FRAPCON-1 and the structural finite element program SAP-IV are applied in a pressurized water reactor fuel rod design methodology. The applied calculation procedure allows to dimension the fuel rod components and characterize its internal pressure. (author).

46835 (IPEN-PUB–188) **A code for structural analysis of fuel assemblies.** Hayashi, I.M.V.; Perrotta, J.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 9p. (In Portuguese). Order Number DE90640014. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

It's presented the code ELCOM for the matrix analysis of tubular structures coupled by rigid spacers, typical of PWR's fuel elements. The code ELCOM makes a static structural analysis, where the displacements and internal forces are obtained for each tubular structure at the joints with the spacers, and also, the natural frequencies and vibrational modes of an equilavent integrated structure are obtained. The ELCOM result is compared to a PWR fuel element structural analysis obtained in published paper. (author).

46836 (IPEN-PUB–189) **Geometrical dimensioning of PWR UO_2 pellets.** Silva, A.T. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 13p. (In Portuguese). Order Number DE90640015. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The finite element structural program SAP-IV is used to calculate UO_2 pellet strains developed under thermal gradients in pressurized water reactors. The applied procedure allows to analyse the influence of various aspects of pelet geometry on cladding strains and can be utilized for the dimensioning of UO_2 pellets. Pellets purchased with flat ends, with dishes pressed into both ends, shouders, and a 45-deg edge chamfer are analysed. The analyse results are compared with experiemtnal data. (author).

46837 (IPEN-PUB–190) **Effects of alloys elements, impurities and microstructural factors in austenitic stainless steel to utilize in fuel rod of nuclear reactors.** Yoshimoto, A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 13p. (In Portuguese). Order Number DE90640016. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Austenitic Stainless Steel is used as cladding material of pressurized water reactor fuel rods because of its good performance. The addition of alloy elements and the control of impurities make this to happen. Fission products do not contribute to corrosion. Dimensional changes are not critical up to $1,0 \times 10^{22} n/cm^2$ (E>0,1 MeV) of neutronic doses. The hydrogen does not cause embrittlement in the reactor operation temperatures, and helium contributes to embrittlement if the material is warmed upon 650^0C. (author).

46838 (IPEN-PUB–191) **Specification of PWR UO_2 pellet design parameters with the fuel performance code FRAPCON-1.** Silva, A.T.; Marra Neto, A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 14p. (In Portuguese). Order Number DE90640017. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

UO_2 pellet design parameters are analysed to verify their influence in the fuel basic properties and in its performance under irradiation in pressurized water reactors. Three groups of parameters are discussed: (1) content of fissionable and impurity materials; (2) stoichiometry; (3) density pore morpholoy, and microstructure. A methodology is applied with the fuel performance program FRAPCON-1 to specify these parameters. (author).

46839 (KWU-R–321/82/333) **Lectures on design and analysis of spherical steel containment vessels.** Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.). 28 Oct 1982. 35p. Source: Copy held by UB/TIB Hannover.

The special concern of this report is to present the method of design practiced, the stress and stability analysis of containments and the optimized design of containment nozzles. The lectures were presented in the years 1979 to 1981. Separate records of all three papers are available in the database. (orig./MM).

46840 (KWU-R–321/82/333, pp. 25-35) **Optimization of the containment nozzles.** Andersen; Bantle. Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.). 28 Oct 1982. In *Lectures on design and analysis of spherical steel containment vessels.* Source: Copy held by UB/TIB Hannover.

After a short description of the nozzles, the activities concerning the stress analysis are described and the results of the optimization are summarized. (orig.).

46841 (KWU-R–321/82/333, pp. 3-12) **Design and analysis of containments - state of the art on introduction of KTA safety standard 3401.2.** Andersen; Bantle. Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.). 28 Oct 1982. In *Lectures on design and analysis of spherical steel containment vessels.* Source: Copy held by UB/TIB Hannover.

In Germany containments for PWR plants are free-standing steel vessels. Design and analysis of the containments have been performed according to KTA Safety Standard 3401.2 since October 1980. The methods of design practiced and the experience gained over the years are reflected in the above Safety Standard and in the relevant analyses. The aim of this paper is to provide a brief outline of the current status. (orig.).

46842 (KWU-R–321/82/333, pp. 13-24) **Stability analysis of spherical metal containment vessels.** Andersen; Bantle; Habip. Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany, F.R.). 28 Oct 1982. In *Lectures on design and analysis of spherical steel containment vessels.* Source: Copy held by UB/TIB Hannover.

The structural stability of spherical metal containment vessels subjected to global loads caused by deadweight, underpressure, and base exications, and to local mechanical loads at penetrations has been investigated theoretically. Corresponding analyses of bifurcation buckling and collapse are presented. Based on experimental data and initial postbuckling theory, knockdown factors are

being determined for spherical shells with complex prebuckling stress distributions. Of special interest are biaxial states of stress with both tensile and compressive components. A realistic interaction of local and global effects must also be considered. (orig.).

46843 (SRD-R-334) **Some factors affecting radiative heat transport in PWR cores.** Hall, A.N. UKAEA Safety and Reliability Directorate, Culcheth (UK). Apr 1989. 18p. Order Number DE90638449. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This report discusses radiative heat transport in Pressurized Water Reactor cores, using simple models to illustrate basic features of the transport process. Heat transport by conduction and convection is ignored in order to focus attention on the restrictions on radiative heat transport imposed by the geometry of the heat emitting and absorbing structures. The importance of the spacing of the emitting and absorbing structures is emphasised. Steady state temperature distributions are found for models of cores which are uniformly heated by fission product decay. In all of the models, a steady state temperature distribution can only be obtained if the central core temperature is in excess of the melting point of UO_2. It has recently been reported that the MIMAS computer code, which takes into account radiative heat transport, has been used to model the heat-up of the Three Mile Island-2 reactor core, and the computations indicate that the core could not have reached the melting point of UO_2 at any time or any place. We discuss this result in the light of the calculations presented in this paper. It appears that the predicted stabilisation of the core temperatures at $\approx 2200^0$C may be a consequence of the artificially large spacing between the radial rings employed in the MIMAS code, rather than a result of physical significance. (author).

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 46882

46844 (Juel-2194) **Investigations to the potential of the high temperature reactor for steam power processes with highest steam conditions and comparison with according conventional power plants.** Mondry, M. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.). Apr 1988. 151p. (In German). Order Number DE90519890. Source: NTIS (US Sales Only), PC A08/MF A01.

Already in the fifties conventional power plants with high parameters of the live steam were built to improve the total efficiency. The power plant with the highest steam conditions in the Federal Republic of Germany has 300 bar pressure and 600deg C temperature. Because of high material costs and other problems power plants with such high conditions were not continued to be built. Standard conditions of today's power plants are in the order of 180-250 bar pressure and 535deg C temperature. As the high temperature reactor is partly built up in another way than a conventional power plant, the results regarding the high steam parameters are not transferable. Possibilities for the technical realization of determined HTR-specific components are introduced and discussed. Then different HTR-power plants with steam conditions up to 350 bar pressure and 650deg C temperature are projected. Economical considerations show that an HTR with higher steam parameters brings financial profits. Further efficiency increase, which is possible by the high steam conditions, is shortly presented. The work ends with a technical and economical comparison of corresponding conventional power plants. (orig./UA).

46845 (NPT-ESTD-L-0071-R89) **Occurrence and prevention of enhanced oxide deposition in boiler flow control orifices.** Woolsey, I.S.; Thomas, D.M.; Garbett, K.; Bignold, G.J. National Power, Leatherhead (UK). Oct 1989. 28p. Order Number DE90638480. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Once-through boilers, such as those of the AGRs, incorporate flow control orifices at the boiler inlet to ensure a satisfactory flow distribution and stability in the parallel flow paths of the boiler. Deposition of corrosion products in the flow control orifice leads to changes in the orifice pressure loss characteristics, which could lead to problems of flow maldistribution within the boiler, and any adverse consequences resulting from this, such as tube overheating. To date, AGR boiler inlet orifices have not suffered significant fouling due to corrosion products in the boiler feedwater. However, oxide deposition in orifices has been observed in other plants, and in experimental loops operating under conditions very similar to those at inlet to AGR boilers. The lack of deposition in AGR flow control orifices is therefore somewhat surprising. This Report describes studies carried out to examine the factors controlling oxide deposition in flow control orifices, the intention of the work being to explain why deposition has not occurred in AGR boilers to date, and to provide means of preventing deposition in the future should this prove necessary. (author).

46846 (ORNL/FTR-3718) **[Graphite technology information exchange and fuels, fission products and graphite]: Foreign trip report, July 6, 1990–July 30, 1990.** Burchell, T.D.; Fuller, E.L. Jr. Oak Ridge National Lab., TN (USA). 29 Aug 1990. 21p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90016878. Source: NTIS, PC A03/MF A01 - OSTI.

Details of the traveler's meetings with research workers in the United Kingdom and Federal Republic of Germany are reported. The meetings, held under the auspices of international agreements (UK/USA and USA/FRG) were concerned with the exchange of data and technical information on graphite for high-temperature gas-cooled reactors. The presentations and ensuing discussions were entirely relevant and extremely beneficial to the travelers' research work for the Modular High-Temperature Gas-Cooled Reactor (MHTGR) technology development program at ORNL. Several papers were presented by the travelers at the international carbon conference, Carbone 90, Paris, France. Many of the several hundred contributions made to the conference were of interest to the travelers. Details of those papers of direct relevance to the program at ORNL are summarized here. 2 refs., 2 figs., 1 tab.

2105 Power Reactors, Breeding

Refer also to citation(s) 46641, 46871, 46880, 47188

46847 (DLR-Mitt.-90-04, pp. 319-331) **On line diagnostics of rotating machinery using expert system technology.** Hohl, F. (Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany, F.R.)); Pinterowitsch, W.; Schmidt, H. Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Koeln (Germany, F.R.). 1990. (CONF-8909362--: 15. international symposium on aircraft integrated monitoring systems (AIMS-15), Aachen (Germany, F.R.), 12-14 Sep 1989). In *Proceedings of the 15th symposium 'Aircraft integrated monitoring systems', September 12-14, 1989 in Aachen.* Source: Available from Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Koeln (Germany, F.R.).

Over the last years it became apparent that on line diagnostics will become more and more important for increasing safety in nuclear power plants and the availability of machinery. Expert system technology in combination with conventional methods for pattern recognition and data preparation turned out to be a favorite candidate for automatic on line diagnostics of rotating machinery and related diagnostical problems. The article describes the conceptual design of an on line diagnostic system for a liquid sodium pump in a nuclear power plant. An overview on the system design, the system parameters, the user interface, and an example for the construction of the knowledge base will be given. (orig.).

46848 (DNE-R-10) **Numerical modelling of natural circulation flows in the PFR inner pool.** Keeton, J.A. UKAEA Dounreay Nuclear Power Development Establishment (UK). Apr 1989. 36p. (CONF-891004--: 4. international topical meeting on nuclear reactor thermal hydraulics, Karlsruhe (Germany, F.R.), 10-13 Oct 1989). Order Number DE90638485. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The thermalhydraulics code ASTEC is used to predict flows for a 2 MW natural circulation test carried out in the prototype fast reactor (PFR). The simulation corresponds to a period 2 hours into the

test when quasi-steady state conditions are well established. A finite element mesh, representing a 60^0 sector of the PFR inner pool together with an associated intermediate heat exchanger, is used for a 3-dimensional calculation where buoyancy forces dictate both flow paths and flow rates. The predicted flow field is in close agreement with a 2-loop mode of flow. The predictions are also in good agreement with the experimental results, and confirm the 2-loop mode explanation for some anomalous temperature measurements. (author).

46849 (EUR–8520) **1982 Annual Status Report Plutonium Fuels and Actinide Programme.** Lindner, R. (European Inst. for Transuranium Elements, Karlsruhe (Germany, F.R.)). Commission of the European Communities, Luxembourg (Luxembourg). 1983. 8p. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The programme of the Transuranium Institute has long included work on advanced fuels for fast breeder reactors. Study of the swelling of carbide and nitride fuels is now nearing completion, the retention of fission gases in bubbles of different sizes in the fuel having been quantified as function of burn-up and temperature. An important step forward has been achieved in the studies of the Equation of State of Nuclear Fuels up to 5000 K. Formation of some of the less abundant isotopes in PWR fuel has been determined experimentally. Aerosol formation during the fabrication of plutonium containing fuels, part of the activity Safe Handling of Plutonium Fuel has been studied. Head-End Processing of carbide fuels has continued experiments with high burn up mixed carbides. In the field of actinide research the preparation and characterisation of pure specimens is carried out. Effect of actinides on the properties of waste glasses is investigated.

46850 (IAEA-TECDOC–514) **Seismic analysis of liquid metal fast breeder reactors.** Gilbert, R.J. (CEA (France)); Martelli, A. International Atomic Energy Agency, Vienna (Austria). Jun 1989. 188p. Order Number DE90638487. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

This report is a general survey of the recent methods to predict the seismic structural behaviour of LMFBRs. It shall put into evidence the impact of seismic analysis on the design of the different structures of the reactor. This report is addressed to specialists and institutions of governmental organizations in industrialized and developing countries responsible for the design and operation of LMFBRs. The information presented should enable specialists in the R and D institutions and industries likely to be involved, to establish the correct course of the design and operation of LMFBRs. Also, the safety aspect of seismic risk are emphasized in the report. Refs and figs.

46851 (KFK–4491e) **TEGENA: Detailed experimental investigations of temperature and velocity distributions in rod bundle geometries with turbulent sodium flow.** Moeller, R. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Schneller Brueter. Dec 1989. 202p. Order Number DE90520030. Source: NTIS (US Sales Only), PC A10/MF A01.

Precise knowlege of the velocity and temperature distributions is necessary in fuel element design (rod bundles with longitudinal flow). The detail codes required in the fine analysis of non-uniformly cooled bundle zones are presently at the stage of development. In order to verify these computer codes, the mean fluid temperatures and the related RMS values of the temperature fluctuations were measured in a heated bundle, TEGENA, containing four rods arranged in one row (P/D = W/D = 1.147) with sodium cooling ($Pr \simeq 0.005$). The temperature distribution in the structures was determined as the necessary boundary condition for the temperature profiles in the fluid. The experiments were carried out with different types of heating (uniform load and flux tilting) and the flow conditions were varied in the ranges $4000 \leq Re \leq 76{,}000$; $20 \leq Pe \leq 400$. The essential processes of thermal development took place under uniform load within a heated bundle length of about 100 hydraulic diameters. In the main measuring plane at the end of the heated zone, after 200 hydraulic diameters, the flow can be termed largely developed thermally. There, the temperature profiles measured in the fluid exhibit pronounced maxima in the narrowest gaps of the subchannels as well as pronounced minima in the centers of the subchannels at the unheated wall. In the zones of maximum temperature gradients the temperature fluctuations attain maximum and minimum values, respectively, at the points of disappearance of the temperature gradients. In all cases of flux tilting investigated the flow at the end of the heated zone had not yet developed thermally. (orig.).

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 46891

46852 (PNL-SA–17201) **Design considerations for a ceramic fabric radiator.** Pauley, K.A. (Pacific Northwest Lab., Richland, WA (USA)); Webb, B.J.; Klein, A.C. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 10p. Sponsored by National Aeronautics and Space Administration. DOE Contract AC06-76RL01830. (CONF-900442–4: Engineering, construction and operations for space, Albuquerque, NM (USA), Apr 1990). Order Number DE90016342. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The design of an Advanced Ceramic Fabric (ACF) thermal management device for use in both interplanetary and near-earth space must consider several important aspects of the environment. First, the radiation field at various locations is dominated by a proton component which deposits its energy on the surface of the device. Second, the ACF materials, as well as pressure liner materials, must also be compatible with the working fluids selected for the system. Third, the fluid dynamics and heat transfer characteristics of this device should be adequately characterized. With the proper consideration of materials and operating conditions, the Bubble Membrane Radiator (BMR) may be utilized for several advanced space missions. 17 refs.

2107 Regulation and Licensing

Refer also to citation(s) 46873

46853 (NUREG–0386-Digest.5-Rev.7) **United States Nuclear Regulatory Commission Staff practice and procedure digest: Commission, Appeal Board and Licensing Board decisions, July 1972–March 1990: Digest No. 5, Rev. 7.** Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel. Aug 1990. 646p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A99/MF A01 - GPO; OSTI; INIS.

This Revision Number 7 of the fifth edition of the NRC Practice and Procedure Digest contains a digest of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period July 1, 1972 to March 31, 1990, interpreting the NRC's Rules of Practice in 10 CFR Part 2.

46854 (NUREG/CR–2000-Vol.9-No.7) **Licensee Event Report (LER) compilation for month of July 1990: Volume 9, No. 7.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Aug 1990. 93p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.9-No.7). Source: NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

This monthly report contains Licensee Event report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022,

Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

46855 (NUREG/CR–5297) **Closeout of IE Bulletin 83-05: ASME nuclear code pumps and spare parts manufactured by the Hayward Tyler Pump Company.** Foley, W.J. (Parameter, Inc., Elm Grove, WI (USA)); Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Events Assessment; Parameter, Inc., Elm Grove, WI (USA). Aug 1990. 31p. Sponsored by Nuclear Regulatory Commission. (PARAMETER/IE–188). Source: NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

Documentation is provided in this report to close IE Bulletin 83-05 regarding ASME nuclear code pumps and spare parts manufactured by the Hayward Tyler Pump Company (HTPC). The bulletin was issued (1) to alert holders of operating licenses and construction permits of nuclear power plants that HTPC failed to implement effectively their quality assurance (QA) program from 1977 to 1981 and (2) to require affected utilities to take action to resolve the potential for failure of the subject pumps and their spare parts. Evaluation of utility responses and NRC/Region inspection reports shows that reliability of the affected pumps was ensured by means of procedures and performance testing of the pumps as required by the bulletin. Based on the evaluation, in accordance with specific criteria, the bulletin is closed for 116 (98%) of the 118 facilities to which it was issued for action and which were not shut down indefinitely or permanently at the time of issuance of this report. A follow-up item is proposed for the two facilities with open bulletin status. Based on favorable results, a conclusion is presented to indicate that the bulletin concerns have been resolved.

2108 Economics

Refer also to citation(s) 46844

22 NUCLEAR REACTOR TECHNOLOGY

Refer also to citation(s) 47358

2201 Theory and Calculation

Refer also to citation(s) 46877, 47890

46856 (CNIC–00250) **2DFGD: a computer code for calculation of two-dimensional few-group neutron diffusion equations.** Zhang Difang (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). China Nuclear Information Centre, Beijing, BJ (China). 1987. 11p. (In Chinese). (IAE–0062). Order Number DE90638368. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This code can be used to solve two-dimensional few-group neutron diffusion equations, to get effective multiplication factor of reactor, distribution of neutron-flux and power. The finite-difference equations is got by integral method. The inner iteration is taken by linear relaxation method. The outer iteration is adopted by power method and it was accelerated by Chebyshev polynomial. X-Y, R-Z, and R-theta geometries may be treated. Various boundary conditions are allowed. It can calculate with four groups, three groups and two groups. The code was written in FORTRAN Language. There are two versions: VAX 11/780 and CYBER 825 versions.

46857 (PSI–47) **Probabilities for lattice integral transport.** Segev, M. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Stepanek, J. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jul 1990. 10p. Order Number DE90639978. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A routine was written to enable an efficient, yet accurate, interpolation of basic probabilities required in integral transport calculations of lattice single as well as multicell structures. These are: (a) transmission and escape probabilities for layers in slab, cylindrical, and spherical geometries, (b) Dancoff probabilities for cylinders in square and hexagonal lattices. The tables within which the routine interpolates contain remainders between accurate probabilities to respective analytical approximations. There are about 4000 entries for a cylindrical or spherical geometry, 50 for slab geometry. The accuracy is a few tenth of a percent, usually much lower, relative error for all the probabilities. The range of optical thickness covered is 0 to 20. All the probabilities for a given layer may be generated on a CRAY-XMP in a 5.10^{-6} seconds. A single Dancoff probability can be generated in about $2.7.10^{-6}$ seconds. (author) 2 figs., 13 refs.

2202 Components and Accessories

Refer also to citation(s) 46852, 46855, 46873, 47167, 47189, 47385, 47699, 47700

46858 (CNIC–00262) **The testing of a steam-water separating device used for vertical steam generators.** Ding Xunshen (Research Inst. of Nuclear Power Operation, Wuhan, HB (China)); Cui Baoyuan; Xue Yunkui; Liu Shixun. China Nuclear Information Centre, Beijing, BJ (China). 1989. 11p. (In Chinese). (RINPO–0005). Order Number DE90638371. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The air-water screening tests of a steam-water separating device used for vertical steam generators at low pressure are introduced. The article puts emphasis on the qualification test of the steam-water separating device at hot conditions in a high temperature and pressure water test rig. The performance of the comprehensive test of the steam-water separating device indicates that the humidity of the steam at the drier exit is much less than the specified amount of 0.25%.

46859 (CNIC–00292) **Using acoustic emission technique to monitor fractures on the analogous pressure pipes.** Zhang Lichen (Southwest Inst. of Nuclear Reactor Engineering, SC (China)). China Nuclear Information Centre, Beijing, BJ (China). Jan 1989. 11p. (In Chinese). (SINRE–0020). Order Number DE90638372. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

By using the acoustic emission technique to monitor the fractures on analogous pressure pipes of the primary circuit which has had cracks and loading with pressure was investigated. The dynamical process, from cracking to fracturing, was recorded by the acoustic emission technique. Comparing with the conventional method, this method gives more informations, such as pre-cracking, cracking growing, fast fracturing and the pressure values at different phases. During testing time a microcomputer was used for real-time data processing and locating the fracturing position. These data are useful for the mechanical analysis of the reactor components.

46860 (CONF-900814–11) **Analysis of instrumented Charpy data in the PR-EDB.** Stallmann, F.W. (Oak Ridge National Lab., TN (USA)); Pachur, D. Oak Ridge National Lab., TN (USA). 1990. 11p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90016856. Source: NTIS, PC A03/MF A01; OSTI; INIS.

A systematic analysis has been performed of the available instrumented Charpy data from surveillance capsule reports which are collected in the Power Reactor Embrittlement Data Base (PR-EDB). Based on ideas by D. Pachur, fractions of the total impact energy that are due to different segments of the load curve are determined and fit separately to Pachur's model. As a first result, a strong linear relation has been found between the upper shelf values, EA, of the energy fractions in segment A and the total upper shelf energy, USE. The relation can be written as: EA = 0.276 USE + 8.64 (joule), and holds for all pressure vessel materials, plates, forgings, and welds, both before and after irradiation in surveillance capsules of commercial power reactors. Based on this relation, a separation into energy fractions can be obtained from the total impact energy alone resulting in an improved fit for Charpy impact data. Conversely, reliable values for the upper shelf energy can be obtained from energy fraction A, if the impact data in the upper shelf region are missing or erratic. The investigation is being extended to data from materials test reactor experiments.

46861 (ESTD-L–0111/R89) **Coping with residual stresses in the integrity assessment of an as-welded repair.** Knee, N. National Power, Leatherhead (UK). Nov 1989. 22p. (CONF-8910199–: European symposium on elastic-plastic fracture mechanics, Freiburg (Germany, F.R.), 9-12 Oct 1989). Order Number DE90639980. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

One of a series of large scale tests on pressure vessels is described, in which a defect was deliberately introduced into an as-welded (i.e. not stress relieved) repair weld. The behaviour of the vessel during pressurization to failure was carefully monitored and the actual performance compared with theoretical predictions. The influence of residual welding stresses on ductile crack growth from pre-existing defects is discussed in the light of the results of this test and of previous tests in the series. The tests have confirmed that residual stresses can exert a significant effect on the growth of fatigue cracks. However, in tests for which the failure mechanism is predominantly controlled by collapse of the remaining ligament, the development of plasticity during pressurization to failure will tend to remove any local residual stresses. (author).

46862 (IPEN-PUB–171) **RELAP4/MOD-5-CEA pump coast-down experiment simulation.** Borges, R.C.; Freitas, R.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 10p. (In Portuguese). Order Number DE90639981. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Since is important the theoretical-experimental comparison to evaluate the computer codes, these paper presents the simulation with RELAP4/MOD5 Code of a loss of power energy in the pump of the "Circuito Experimental de Agua-CEA". From the results attained, the existing models in the Code showed to be very satisfatory quantitative and qualitative behavior of the attained experimental results. (author).

46863 (NPT-ESTD-L–0114-R89) **An experimental study of flow and heat transfer in generator rotor cooling ducts: Pt. 3: Recommissioning the rig with the second test section.** Stephenson, P.L.; Gawman, F.H. National Power, Leatherhead (UK). Jan 1990. 53p. Order Number DE90638373. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The rotor windings of large turbogenerators are generally cooled by passing hydrogen through hollow copper conductors. A rig has been built to measure the effects of rotation on flow and heat transfer in such cooling systems. It models a commonly used geometry, namely a duct rotating about a parallel axis, but using air as a working fluid. Tests have now been completed with a second test section that includes static pressure tappings as well as a heater and thermocouples. The aim with this test section was to measure the static pressure drop as well as heat transfer in a heated rotating tube. The aim of this Report is to describe the second test section and also the associated changes that have been made to the rig itself and the computer software used with it. Various investigations have been made as part of the commissioning of the rig with the second test section, and they are reported here. A subsequent Report will describe the results that have been obtained for conditions corresponding to actual generator rotors. (author).

46864 (NUREG/CR–4908) **Ultrasonic inspection reliability for intergranular stress corrosion cracks: A round robin study of the effects of personnel, procedures, equipment and crack characteristics.** Heasler, P.G. (Pacific Northwest Lab., Richland, WA (USA)); Taylor, T.T.; Spanner, J.C.; Doctor, S.R.; Deffenbaugh, J.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 149p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC06-76RL01830. (PNL–6196). Source: NTIS, PC A07/MF A01 - GPO - OSTI.

A pipe inspection round robin entitled "Mini-Round Robin" was conducted at Pacific Northwest Laboratory from May 1985 through October 1985. The research was sponsored by the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research under a program entitled "Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactors." The Mini-Round Robin (MRR) measured the intergranular stress corrosion (GSC) crack detection and sizing capabilities of inservice inspection (ISI) inspectors that had passed the requirements of IEB 83-02 and the Electric Power Research Institute (EPRI) sizing training course. The MRR data base was compared with an earlier Pipe Inspection Round Robin (PIRR) that had measured the performance of inservice inspection prior to 1982. Comparison of the MRR and PIRR data bases indicates no significant change in the inspection capability for detecting IGSCC. Also, when comparing detection of long and short cracks, no difference in detection capability was measured. An improvement in the ability to differentiate between shallow and deeper IGSCC was found when the MRR sizing capability was compared with an earlier sizing round robin conducted by the EPRI. In addition to the pipe inspection round robin, a human factors study was conducted in conjunction with the Mini-Round Robin. The most important result of the human factors study is that the Relative Operating Characteristics (ROC) curves provide a better methodology for describing inspector performance than only probability of detection (POD) or single-point crack/no crack data. 6 refs., 55 figs., 18 tabs.

46865 (NUREG/CR–5583) **Prediction of check valve performance and degradation in nuclear power plant systems: Wear and impact tests: Final report, September 1988–April 1990.** Kalsi, M.S. (Kalsi Engineering, Inc., Sugar Land, TX (USA)); Horst, C.L.; Wang, J.K.; Sharma, V. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Kalsi Engineering, Inc., Sugar Land, TX (USA). Aug 1990. 115p. Sponsored by Nuclear Regulatory Commission. (KEI–1656). Source: NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

Check valve failures in nuclear power plants have led to safety concerns as well as extensive damage and loss of plant availability in recent years. Swing check valve internals may experience premature deterioration if the disc is not firmly held open against its stop. At the present time no guidelines exist for the prediction of degradation trends and the determination of suitable inspection intervals. This research is aimed at developing a reliable quantitative wear and fatigue prediction model for swing check valves which can be used to improve the safety and reliability of their operation. Additionally, the predictive techniques can be used to augment check valve preventive maintenance programs by providing the plant engineer with quantitative and conservative estimates of damage potential for check valve internals. 21 refs., 30 figs., 8 tabs.

46866 **Pull rod assembly.** Cioletti, O.C. To Dept. of Energy, Washington, DC (USA). USA Patent 4,926,745/A/. 22 May 1990. Filed date 21 Apr 1988. USA Patent Application 7-184,327. Int. Cl. F16J 1/00. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a pull rod assembly. It comprises: a pull rod having three peripheral grooves, a piston device including an adaptor ring and a seal ring. The piston device is mounted on the pull rod by a split ring retainer situated in one groove and extending into an interior groove in the adaptor and a resilient split ring retained in another groove and positioned to engage the piston device and to retain the seal on its adaptor.

2203 Fuel Elements

Refer also to citation(s) 46834, 46835, 47217, 47365

46867 (UJV–8597-M) **Failure criterion of thin-walled tubes subjected to proportional and non-proportional loading.** Novak, J.; Lauerova, D. Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia). Apr 1989. 17p. Order Number DE90638387. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The values are predicted of critical deformation for localized fuel can necking under proportional and non-proportional loads. The theoretical models are assessed of critical deformation relations on the deformation pathway, and constitutive equations are formulated and applied to anisotropic material under a non-proportional load. Bifurcation analysis is performed of localized necking based on improved description of the orthotropic material plasticity area under a proportional load. The results obtained are compared with experiments, and the effect is assessed of the constitutive material description on the predicted critical deformation values. (author). 7 figs., 27 refs.

2204 Control Systems

46868 (CONF-900607–5) **Issues of integrating high-tech concepts into nuclear power plant operation.** Kisner, R.A. (Oak Ridge National Lab., TN (USA)); Carter, R.J.; Lindsay, R.W. Oak Ridge National Lab., TN (USA). [1990]. 27p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From Advances in human factors research on man-computer interactions: nuclear and beyond; Nashville, TN (USA); 10-15 Jun 1990. Order Number DE90016021. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The stockpile of new ideas continues to grow for monitoring nuclear power plant parameters, characteristics, and vital signs and for controlling systems, subsystems, and components. This wide selection of monitoring and control software increases the difficulty of designing an integrated control room. As plant control room operators increase their reliance on computerized systems, including real-time plant data and data base systems, the integration of monitoring, diagnostics, and control software into uniform and seamless environment becomes imperative. A systematic approach to evaluating the usefulness of such high-tech control concepts is needed. This paper concentrates on methods to evaluate control concepts by assessing factors that determine a system's potential effectiveness within the context of the overall environment, including both human and machine components. Although not an in-depth study, this paper serves to outline several measures of utility. 21 refs., 3 figs., 2 tabs.

46869 (IAEA-TECDOC–546) **Common modelling approaches for training simulators for nuclear power plants: Final report of a co-ordinated research programme, January 1985 to November 1988.** International Atomic Energy Agency, Vienna (Austria). Feb 1990. 59p. Order Number DE90638395. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Training simulators for nuclear power plant operating staff have gained increasing importance over the last twenty years. One of the recommendations of the 1983 IAEA Specialists' Meeting on Nuclear Power Plant Training Simulators in Helsinki was to organize a Co-ordinated Research Programme (CRP) on some aspects of training simulators. The goal statement was: "To establish and maintain a common approach to modelling for nuclear training simulators based on defined training requirements". Before adapting this goal statement, the participants considered many alternatives for defining the common aspects of training simulator models, such as the programming language used, the nature of the simulator computer system, the size of the simulation computers, the scope of simulation. The participants agreed that it was the training requirements that defined the need for a simulator, the scope of models and hence the type of computer complex that was required, the criteria for fidelity and verification, and was therefore the most appropriate basis for the commonality of modelling approaches. It should be noted that the Co-ordinated Research Programme was restricted, for a variety of reasons, to consider only a few aspects of training simulators. This report reflects these limitations, and covers only the topics considered within the scope of the programme. The information in this document is intended as an aid for operating organizations to identify possible modelling approaches for training simulators for nuclear power plants. 33 refs.

46870 (IPEN-PUB–187) **A method to determine the dampening system of control rod drop mechanism for PWR reactors.** Trindade, C.E.; Mattos, J.R.L. de; Perrotta, J.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 8p. (In Portuguese). Order Number DE90640001. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A method to determine the Control Assembly damping drop system (dashpot/guide tube) was developed. It's presented a theoretical model, an experimental device and the procedures to determine this system, which is used in PWR reactors. (author).

46871 (IWGFR–69) **Methods for reactor physics calculations for control rods in fast reactors: Proceedings of a specialists meeting.** Grimstone, M.J. (UKAEA Atomic Energy Establishment, Winfrith (UK). Reactor Physics Div.); Rowlands, J.L. (eds.). International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors. May 1990. 441p. Sponsored by International Atomic Energy Agency. (CONF-881252–: IAEA specialists' meeting, Winfrith (UK), 6-8 Dec 1988). Order Number DE90016214. Source: NTIS (US Sales Only), PC A18/MF A01 - OSTI.

The purpose of this specialists meeting was to review the current calculational methods and their accuracy as assessed by theoretical studies and comparisons with measurements, and then to identify the requirements for improved methods or additional studies and comparisons. The control rod properties or effects to be considered were their reactivity worths, their effect on the power distribution through the core, and the reaction rates and energy deposition both within and adjacent to the rods. The meeting was divided into five sessions, in the first of which each national delegation presented a brief overview of their programme of work on calculational methods for fast reactor control rods. In the next three sessions a total of seventeen papers were presented describing calculational methods and assessments of their accuracy. The final session was a discussion to draw conclusions regarding the current status of methods and the further developments and validation work required. Individual papers have been catalogued separately.

46872 (NUREG/CR–5572) **An evaluation of the effects of local control station design configurations on human performance and nuclear power plant risk.** O'Hara, J. (Brookhaven National Lab., Upton, NY (USA)); Ruger, C.; Higgins, J.; Luckas, W.; Crouch, D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Brookhaven National Lab., Upton, NY (USA). Sep 1990. 53p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–52236). Source: NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

A human factors analysis was performed to assess how identified upgrades to local control stations (LCSs) in nuclear power plants affect both human performance and plant risk. Upgrades in the design of individual control panels and overall improvement of functional centralization were considered. The analysis methodology was accomplished in four stages. First, a list of LCS human engineering design deficiencies was developed using data collected from a variety of sources including visits to nuclear power plants. From these data, a set of potential upgrades were defined to correct the deficiencies. Second, the effects of the upgrades on human error probabilities (HEPs) were determined using a computer-based methodology for soliciting expert judgement. Third, the HEPs were propagated through plant probabilistic risk assessment (PRA), and new core melt frequencies were established. A preliminary, scoping value-impact assessment was performed to evaluate the regulatory need for further review of possible action to improve the human factors engineering aspects of local control stations. The results indicated that implementation of both types of upgrades would improve human performance and lower risk, but that only the panel design improvements would be cost beneficial. 14 refs., 9 figs., 20 tabs.

46873 **Consideration in the evaluation of concrete structures for continued service in aged nuclear power plants (NPPs).** Navs, D. (Oak Ridge National Lab., TN (USA)); Marchbanks, M.; Oland, B.; Arndt, G.; Brown, T. *Proceedings of the American Power Conference (USA)*, 51: 827-832 (1989). DOE Contract AC05-84OR21400. (CONF-890425–: American power conference, Chicago, IL (USA), 24-26 Apr 1989).

This paper discusses the deferral of nuclear power plants currently under construction. Factors involved in the erosion of the economic advantage of nuclear power are presented. The authors propose the extension of operating licenses of existing NPPs as a solution for meeting future electricity demand.

2205 Environmental Aspects

Refer also to citation(s) 46883, 46886, 46888, 47744

46874 (CDTN-DERL-PD–004/82) **Environmental monitoring program for Itataia industrial complex before operational phase.** Condessa, M.L.M.B. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Jan 1982. 35p. (In Portuguese). Order Number DE90639741. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This environmental monitoring program aims to characterize the environment in adjacent area of Itataia Industrial Complex. The places and frequencies of samples and measurements, as well as analysis and parameters to be measured in each type of samples are presented. (C.M.).

46875 (EPRI-NP–6917-M) **Volume reduction technologies for ion-exchange resins arising from full-system decontamination of nuclear power reactors: Final report.** LeSurf, J.E. (PN Services, Inc., Richland, WA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); PN Services, Inc., Richland, WA (USA). ©Aug 1990. 19p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

The decontamination of the full system of light water reactors, including flow through the reactor, with or without fuel, will confer significant savings in worker radiation exposure. A major cost of such a decontamination is the handling and disposal of the large amounts of radioactive resins generated by the decontamination. In this study, methods currently available or under development which could be used to reduce the volume of such resins before disposal are examined. Parameters were defined for both existing and new processes by which to evaluate the processes. Each parameter was given a weighting factor depending on it's perceived importance. Each process was given a rating factor for each parameter. The product of the rating and weighting factors was used to evaluate each process for each parameter. The sum of all the products for each process gave an overall evaluation rating for the process. Several existing and developing processes were identified which should assist in making full system decontaminations more attractive and cost effective.

2207 Plutonium and Isotope Production Reactors

46876 (WHC-SP–0592) **K Area water system upgrades task: Management plan.** Frier, W.A. Westinghouse Hanford Co., Richland, WA (USA). Aug 1990. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90017267. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The K Area Water System Upgrades Task is one of two tasks comprising the KE/KW Operations Standardization and Water System Upgrades Program. The purpose of this plan is to define the subject task and state how it will be managed. The plan includes: a definition of the task objectives and scope; a review of the task background; a description of the activities required to accomplish the task objectives; a description of the organization, projected cost and schedule, funding, controls, reporting and records required to accomplish the task; a discussion of the potential risks associated with performing the task; and identification of the quality assurance and safety controls to be applied to the task. The objectives of this task are to provide water system upgrades and a replacement basin heat removal system to ensure the reliable, safe, and cost-effective operation of the 100K Area site, and to achieve the requisite quality of all task activities in a radiologically safe, environmentally sound and cost-effective manner with a minimum exposure to personnel. 18 refs., 2 figs.

2208 Propulsion Reactors

Refer also to citation(s) 46638

2209 Reactor Safety

Refer also to citation(s) 46724, 46831, 46855, 46865, 46872, 46873, 46875, 47698, 47699, 47700, 47783, 47872, 47921, 47922, 47927

46877 (DOE/NCT–04) **A review of criticality accidents: Revision.** Stratton, W.R.; Smith, D.R. Lawrence Livermore National Lab., CA (USA). Mar 1989. 64p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-7405-ENG-48. Order Number DE90015896. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Criticality accidents and the characteristics of prompt power excursions are discussed. Forty-one accidental power transients are reviewed. In each case where available, enough detail is given to help visualize the physical situation, the cause or causes of the accident, the history and characteristics of the transient, the energy release, and the consequences, if any, to personnel and property. Excursions associated with large power reactors are not included in this study, except that some information on the major accident at the Chernobyl reactor in April 1986 is provided in the Appendix. 67 refs., 21 figs., 2 tabs.

46878 (EPRI-NP–6949) **Proceedings: Sixth International RETRAN conference.** Agee, L.J. (ed.). Electric Power Research Inst., Palo Alto, CA (USA). ©Aug 1990. 761p. Sponsored by Electric Power Research Institute. (CONF-8909248–: 6. international RETRAN meeting, Washington, DC (USA), 17-20 Sep 1989). Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

The RETRAN computer code, developed by EPRI through its Contractors, EI International, Inc. (EI) and Computer Simulation and Analysis, Inc. (CSA), is now widely used by the international nuclear community for various types of safety analyses. In order to exchange information concerning the current use of the code by the various organizations, EPRI sponsored the Sixth International RETRAN meeting in Washington, DC on September 17–20, 1989. The opening session featured a panel discussion on "Licensing Issues of the Nineties" by representatives from NUMARC, Wolf Creek, and Entergy Services, Inc. as well as a review of RETRAN activities during 1988 and 1989. During the three-day meeting, 28 technical papers were presented by the various participants. The papers can be generally classified as: RETRAN-03 development, verification and validation; RETRAN-02 analysis of PWRs; and RETRAN-02 analysis of BWRs. The entire text of all of the papers is included in this special EPRI report. In addition, these proceedings contain the text of seven technical reports presented at a poster session. Each individual paper has been cataloged separately.

46879 (INIS-mf–12626) **The TMI-2 accident.** Loureiro, L.A. Comision Nacional de Energia Atomica, Montevideo (Uruguay). 1986. 125p. (In Spanish). Order Number DE90638244. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

A critical study about the technical and man-related facts in order to establish what is considered the worst commercial nuclear power accident until 1986. Radiological consequences and stress to the public are considered in contrast to antinuclear groups. This descriptive and technical study has the purpose to document written and oral opinions obtained abroad and then explain to the public in an easy language terminology. Preliminary study describing safety related systems fails and the accident itself with minute to minute description, conduct to the consequences and then, to learned lessons.

46880 (LA–11692-MS-Vol.1) **AFDM: An Advanced Fluid-Dynamics Model: Volume 1, Scope, approach, and summary.** Bohl, W.R. (Los Alamos National Lab., NM (USA)); Parker, F.R.; Wilhelm, D.; Berthier, J.; Goutagny, L. Los Alamos National Lab., NM (USA). Sep 1990. 109p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order Number DE90016723. Source: NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

AFDM, or the Advanced Fluid-Dynamics Model, is a computer code that investigates new approaches simulating the multiphase-flow fluid-dynamics aspects of severe accidents in fast reactors. The AFDM formalism starts with differential equations similar to those in the SIMMER-II code. These equations are modified to treat three velocity fields and supplemented with a variety of new models. The AFDM code has 12 topologies describing what material contacts are possible depending on the presence or absence of a given material in a computational cell, on the dominant liquid, and on the continuous phase. Single-phase, bubbly, churn-turbulent, cellular, and dispersed flow regimes are permitted for the pool situations modeled. Virtual mass terms are included for vapor in liquid-continuous flow. Interfacial areas between the continuous and discontinuous phases are convected to allow some tracking of phenomenological histories. Interfacial areas are also modified by models of nucleation, dynamic forces, turbulence, flashing, coalescence, and mass transfer. Heat transfer is generally treated using

engineering correlations. Liquid-vapor phase transitions are handled with the nonequilibrium, heat-transfer-limited model, whereas melting and freezing processes are based on equilibrium considerations. Convection is treated using a fractional-step method of time integration, including a semi-implicit pressure iteration. A higher-order differencing option is provided to control numerical diffusion. The Los Alamos SESAME equation-of-state has been implemented using densities and temperatures as the independent variables. AFDM programming has vectorized all computational loops consistent with the objective of producing an exportable code. 24 refs., 4 figs.

46881 (LBL–26455, pp. 98) **Dissolution of uranium dioxide by molten zircaloy.** Kim, K.T.; Olander, D.R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The morphology, reaction products, kinetics, and mechanisms of the reaction of UO_2 with Zircaloy were investigated in laboratory tests at temperatures between 1,900 and 2,200°C and times from 10 to 200 sec. To avoid unstable density gradients and the resulting bulk motion of the melt, a disk of UO_2 was used as the bottom of a crucible with walls of thoria to contain the liquid metal. Polished sections of the post-test specimens were examined by optical microscopy, scanning electron microscopy, Auger electron spectroscopy, and electron microprobe analysis. The complicated structures observed in the quenched specimens, which contained up to seven distinct regions, could, with the aid of phase diagrams, be traced to a two-phase interaction region at high temperature. Both the kinetic analysis of oxygen and the uranium migration into the melt were based on a diffusion model and utilized measured solubilities of these elements in the melt and data on UO_2 specimen thickness decrease and concentration distributions in the specimen. Dissolution of the inner walls of UO_2 crucibles by molten Zircaloy was also studied. The solubility of uranium in the melt depends strongly on the oxygen content of the latter, which must be determined by accounting for all sources. Application of the results to estimate fuel dissolution during severe fuel damage of nuclear reactor fuel elements showed that the liquefaction process reaches completion in about 100 sec at 2,100°C.

46882 (NUREG–1272-Vol.4-No.1) **Office of Analysis and Evaluation of Operational Data 1989 annual report, Power reactors.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data. Jul 1990. 258p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A12/MF A01 - GPO; OSTI; INIS.

The annual report of the US Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) is devoted to the activities performed during 1989. The report is published in two separate parts. This document, NUREG-1272, Vol. 4, No. 1, covers power reactors and presents an overview of the operating experience of the nuclear power industry from the NRC perspective, including comments about the trends of some key performance measures. The report also includes the principal findings and issues identified in AEOD studies over the past year and summarizes information from such sources as licensee event reports, diagnostic evaluations, and reports to the NRC's Operations Center. This report also compiles the status of staff actions resulting from previous Incident Investigation Team (IIT) reports. 16 figs., 9 tabs.

46883 (NUREG–1420) **Special committee review of the Nuclear Regulatory Commission's severe accident risks report (NUREG–1150).** Kouts, H.J.C. (Defense Nuclear Facility Safety Board (USA)); Apostolakis, G.; Kastenberg, W.E.; Birkhofer, E.H.A.; Hoegberg, L.G.; LeSage, L.G.; Rasmussen, N.C.; Teague, H.J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Aug 1990. 82p. Sponsored by Nuclear Regulatory Commission. Source: NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

In April 1989, the Nuclear Regulatory Commission's (NRC) Office of Nuclear Regulatory Research (RES) published a draft report "Severe Accident Risks: An Assessment for Five US Nuclear Power Plants," NUREG-1150. This report updated, extended and improved upon the information presented in the 1974 "Reactor Safety Study," WASH-1400. Because the information in NUREG-1150 will play a significant role in implementing the NRC's Severe Accident Policy, its quality and credibility are of critical importance. Accordingly, the Commission requested that the RES conduct a peer review of NUREG-1150 to ensure that the methods, safety insights and conclusions presented are appropriate and adequately reflect the current state of knowledge with respect to reactor safety. To this end, RES formed a special committee in June of 1989 under the provisions of the Federal Advisory Committee Act. The Committee, composed of a group of recognized national and international experts in nuclear reactor safety, was charged with preparing a report reflecting their review of NUREG-1150 with respect to the adequacy of the methods, data, analysis and conclusions it set forth. The report which precedes reflects the results of this peer review.

46884 (NUREG/CR–4674-Vol.11) **Precursors to potential severe core damage accidents, 1989: A status report: Main report and Appendix A: Volume 11.** Minarick, J.W. (Science Applications International Corp., Oak Ridge, TN (USA)); Dolan, B.W.; Cletcher, J.W.; Copinger, D.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Programs; Oak Ridge National Lab., TN (USA). Aug 1990. 174p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.11). Source: NTIS, PC A08/MF A01 - GPO; OSTI; INIS.

Thirty operational events with conditional probabilities of core damage of 1.0×10^{-6} or higher occurring at commercial light-water reactors during 1989 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1988 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the analysis process. This document, Volume 2, provides the main report and also Appendix A, which discusses the ASP models used for analysis. 25 figs., 31 tabs.

46885 (NUREG/CR–4674-Vol.12) **Precursors to potential severe core damage accidents, 1989: A status report: Appendices B and C: Volume 12.** Minarick, J.W. (Science Applications International Corp., Oak Ridge, TN (USA)); Dolan, B.W.; Cletcher, J.W.; Copinger, D.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Programs; Oak Ridge National Lab., TN (USA). Aug 1990. 513p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.12). Source: NTIS, PC A22/MF A01 - GPO; OSTI; INIS.

Thirty operational events with conditional probabilities of core damage of 1.0×10^{-6} or higher occurring at commercial light-water reactors during 1989 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1988 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the analysis process. This document, Volume 12, contains appendices B and C of the main report.

46886 (NUREG/CR–5567) **PWR dry containment issue characterization.** Yang, J.W. (Brookhaven National Lab., Upton, NY (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; Brookhaven National Lab., Upton, NY (USA). Aug 1990. 202p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–52234). Source: NTIS, PC A10/MF A01 - GPO; OSTI; INIS.

Severe accident issues have been characterized for pressurized water reactors with large dry containments. A description of PWR dry containment performance under severe accident conditions is provided. Reviews and discussions of early containment failure due

to direct containment heating (DCH), in-vessel steam explosions, hydrogen burns and steam spikes, late containment failure due to gradual overpressurization and basemat melthrough, and containment bypass (interfacing systems LOCA) events are included. An assessment of potential improvements such as RCS depressurization, reactor cavity reflooding, hydrogen control, containment venting and accident management strategy is presented. The review and discussion are largely based on existing information obtained from the nuclear industry and the NRC's severe accident research programs. Additional analyses related to operator actions were performed and are presented in the Appendices. 49 refs., 11 figs., 23 tabs.

46887 (PNL-SA-18160) **Approaches to estimating decommissioning costs.** Smith, R.I. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9006264--1: 65. international western annual economic association conference, San Diego, CA (USA), 29 Jun - 3 jul 1990). Order Number DE90016533. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The chronological development of methodology for estimating the cost of nuclear reactor power station decommissioning is traced from the mid-1970s through 1990. Three techniques for developing decommissioning cost estimates are described. The two viable techniques are compared by examining estimates developed for the same nuclear power station using both methods. The comparison shows that the differences between the estimates are due largely to differing assumptions regarding the size of the utility and operating contractor overhead staffs. It is concluded that the two methods provide bounding estimates on a range of manageable costs, and provide reasonable bases for the utility rate adjustments necessary to pay for future decommissioning costs. 6 refs.

46888 (PSI-59) **Prediction of fission product and aerosol behaviour during a postulated severe accident in a LWR: Methodology developed in the Program Light Water Reactor Safety (PSI).** Guentay, S. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Aeby, F.; Raguin, M.; Passalacqua, R. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Feb 1990. 32p. Order Number DE90638254. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Lack of appropriate energy removal causes fuel elements in a reactor core to overheat and may eventually cause core to degrade. Fission products will be emitted from a degraded reactor core. Aerosols are generated when the vapours of various fuel and structural materials reach a cold environment and nucleate. In addition to the fission products release and aerosol generation taking place in the reactor vessel, some more fission products release and aerosol generation will occur when the molten core debris leaves the pressure vessel bottom head and comes in contact with the pedestal concrete floor. Fission products, if they are released to environment from the containment boundary, exert a great danger to public health. A source term is defined as the quantity, timing, and characteristics of the release of radionuclide material to the environment following a postulated severe accident. At PSI a considerable effort hase been spent in investigating and establishing a source term assessment methodology in order to predict the source term for a given Light Water Reactor (LWR) accident scenario. This report introduces the computer programs and the methods associated with the release of the fission products, generation of the aerosols and behaviour of the aerosols in LWR compartments used for a source term assessment analysis at PSI. (author) 4 figs., 5 tabs., 28 refs.

46889 (PSI-64) **A model for the computation of the thermal processes in the reactor cavity during a severe accident in a LWR, at the presence of sump water, from the time of reactor pressure vessel failure to the start time of melt/concrete interaction.** Hirschmann, H. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Apr 1990. 23p. (In German). Order Number DE90638255. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

At present no experimental results are available which analyze that stage of a severe accident in a light water reactor, during which the reactor pressure vessel fails by melting, the core debris relocates into the water pool on the floor of the containment building (cavity) and again is heated up. Therefore an analytical model is described, with the help of which the process of material relocation, the heating of the material in the cavity interacting with the pool water, and the production rates of vapour and hydrogen can be estimated. The slumped mass accumulating in the cavity is taken to be the sum of infinitely small mass parts, assumed to slump at different times, which after slumping undergo individual thermal histories. The enthalpy of the slumped mass is the sum of the enthalpies of the single mass parts. The average temperature of the slumped mass is given by the enthalpy computed in this manner. The production rates of the gases are additive superpositions of all partial rates from the mass parts. The gas rates are computed using the balance of enthalpy and mass. (author) 5 refs.

46890 (SAND-90-2313C) **Accident sequence frequency analysis: Perspectives and limitations.** Camp, A.L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-9009226--2: Committee on safety of nuclear installations (CSNI), Santa Fe, NM (USA), 4-6 Sep 1990). Order Number DE90016869. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The success of probabilistic risk assessment (PRA) has led to numerous improvements to the safety of commercial nuclear power plants. Those very successes, however, have led to situation where the events that PRAs have traditionally modeled are extremely rare. As a result, current PRAs have the potential to be misleading because events previously considered to be unimportant and, thus, not included in the scope of the analyses may now be dominant. This paper provides an assessment of the current status of accident sequence analysis methods and identifies particular limitations that should be addressed in future studies.

46891 Quality verification of the high flux isotope reactor including lessons learned. Lotts, A.L. (Martin Marietta Energy Systems, Inc. (US)). pp. 1-1 of International waste management conference. American Society for Quality Control, Milwaukee, WI (USA) (1989). (CONF-890487--: International waste management conference, Las Vegas, NV (USA), 2-5 Apr 1989).

This paper discusses the high flux isotope reactor (HFIR), a high performance research reactor used primarily for the production of transplutonium isotopes, special isotopes, accelerated irradiation of materials, and basic research of materials properties and physics. The shutdown caused by embrittlement of the pressure vessel and restart of the reactor are presented. The author presents an overview of the reviews conducted and improvement made.

46892 Modeling for quantifying ultrasonic test system component interaction: The interaction matrix study. Mart, G.A. (Pacific Northwest Lab., Richland, WA (USA)); Doctor, S.R. pp. 325-332 of Proceedings of the 8th international conference on NDE in the nuclear industry. Stahl, D. American Society for Metals, Metals Park, OH (USA) (1986). (CONF-8611147--: 8. international conference on NDE in the nuclear industry, Kissimmee, FL (USA), 17-19 Nov 1986).

This paper discusses a study that has investigated the interaction between hardware components involved in a ultrasonic inspection. Uncontrolled frequency bandpass mismatches between ultrasonic test system components and their results are described.

24 POWER TRANSMISSION AND DISTRIBUTION

46893 (CRIE-Y-89006) **Survey of the current pattern recognition techniques for computerizing the electric facilities' maps.** Yazawa, T.; Nakajima, C. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Mar 1990. 46p. (In Japanese). Order Number DE90517066. Source: NTIS (US Sales Only), PC A03/MF A01.

In order to manage a large quantity of drawings such as line maps and electric facility drawings, the efficient techniques to digitize, recognize, and understand the meaning of maps, were studied in this research. A series of the map management process composed of automatic digitizing of maps up to the construction of

knowledge-base identifying of their meaning, are comprised of following three steps: digitizing process of maps; recognition of maps; understanding the meaning of maps. The weak points of the current techniques are as follows: there is a possibility to take wrong processing on digitizing process due to the factors such as noise and indistinct shapes of maps; due to the strict notation rules on digitizing process of maps, there are many difficulties to recognize any insignificant mistake which can be disregarded supposing by human being; there has been no effective method yet to know how to digitize, recognoze, understand, construct, and represent the meaning on understanding process of map meaning. In order to resolve the above points, the application of a fuzzy logic, construction, and study by meaning net-work on recognition process of maps, is required. 69 refs., 10 figs., 1 tab.

2401 Power Systems

Refer also to citation(s) 46780

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 46794, 46800, 46809, 46936

46894 (EPRI-EL–6943-Vol.1-Pt.1) **Flexible ac transmission systems (FACTS): Scoping study: Volume 1, Part 1, Analytical studies: Final report.** Ewart, D.N. (Power Technologies, Inc., Schenectady, NY (USA)); Koessler, R.J.; Mountford, J.D. Electric Power Research Inst., Palo Alto, CA (USA); Power Technologies, Inc., Schenectady, NY (USA). ©Aug 1990. 97p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This is the first of two scoping studies of the Flexible ac Transmission System (FACTS). It investigates the possibility of using high speed thyristor based control of HVAC power system elements to enhance the carrying capacity of existing transmission circuits without compromising reliability. A study system representative of existing power systems were developed. The studies were conducted on this system to evaluate the economic and technical issues of loading transmission lines to their thermal limits. Two scenarios were considered, a multi-line corridor and a long radial interconnection. The issues addressed were transient and dynamic stability, loop flow control, power flow control, reactive support and voltage stability. 4 refs., 29 figs., 11 tabs.

46895 (EPRI-EL–6959-Vol.1) **The dc modeling program (DCMP): Version 2.0: Volume 1, Model development details: Final report.** Chapman, D.G. (Manitoba HVDC Research Centre, Winnipeg, MB (Canada)). Electric Power Research Inst., Palo Alto, CA (USA); Manitoba HVDC Research Centre, Winnipeg, MB (Canada). ©Aug 1990. 59p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

In this project one of the main objectives was the refinement of tools for the study of HVDC systems. The original software was prepared in project RP1964-2 (EL-4365) as power flow and stability program models for HVDC systems. In this project new modeling capabilities were added to both the power flow and stability models. Additionally, the HVDC specific model capabilities were integrated into a new program, termed the Standalone program, for use in the development and testing of HVDC models.

46896 (EPRI-EL–6959-Vol.2) **The dc modeling program (DCMP): Version 2.0: Volume 2, User's and applications manual: Final report.** Chapman, D.G. (Manitoba HVDC Research Centre, Winnipeg, MB (Canada)). Electric Power Research Inst., Palo Alto, CA (USA); Manitoba HVDC Research Centre, Winnipeg, MB (Canada). ©Aug 1990. 349p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

In this project one of the main objectives was the refinement of tools for the study of HVDC systems. The original software was prepared in project RP1964-2 (EL-4365) as power flow and stability program models for HVDC systems. In this project new modeling capabilities were added to both the power flow and stability models. Additionally, the HVDC specific model capabilities were integrated into a new program, termed the Standalone program, for use in the development and testing of HVDC models. This volume provides information on the application of the software in the form of a User's Manual.

46897 (EPRI-EL–6959-Vol.3) **The dc modeling program (DCMP): Version 2.0: Volume 3, Technical manual: Final report.** Chapman, D.G. (Manitoba HVDC Research Centre, Winnipeg, MB (Canada)). Electric Power Research Inst., Palo Alto, CA (USA); Manitoba HVDC Research Centre, Winnipeg, MB (Canada). ©Aug 1990. 383p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

In this project one of the main objectives was the refinement of tools for the study of HVDC systems. The original software was prepared in project RP1964-2 (EL-4365) as power flow and stability program models for HVDC systems. In this project new modeling capabilities were added to both the power flow and stability models. Additionally, the HVDC specific model capabilities were integrated into a new program, termed the Standalone program, for use in the development and testing of HVDC models. This manual provides technical background for programmers and those interested in understanding, augmenting or transporting the dc models.

2407 Economic, Industrial, and Business Aspects

46898 (CRIE-Y–89005) **Customer's choice between quality and price of electric service.: Behavioral analysis for large-scale computer users to choose back-up power system.** Fujii, Y.; Matsukawa, I. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Mar 1990. 46p. (In Japanese). Order Number DE90517065. Source: NTIS (US Sales Only), PC A03/MF A01.

This study is done for the purpose of numerically analyzing how customers react to make their choice between quality and price, as well as to evaluating the marketability of the new electric service differentiated by quality, on the assumption that electric utility is capable of providing the multi-product of the service with various combinations instead of the conventional single product between price and quality. An analysis was made for the customers like the large-scale computer users those who attach importance to quality. As for the method of the analysis, the choice (the introduction of emergency power source or uninterruptible power system) which have been actually done by the customers for the following two conditions, were used as the model of the analysis: The one was the standard of the requirements for the quality of electric power, of which requirements were composed of the two factors, such as the reliability on power supply and momentary voltage drop; The other was the cost (purchased power price plus investment by consumers for back-up power system) necessary to maintain the quality. Consequently, it was found that in order to heighten the competitiveness for the competition in electricity market, electric utility had to establish their service rate corresponding to the load, as well as that the quality was a important strategic factor for them. 30 refs., 10 figs., 9 tabs.

25 ENERGY STORAGE

2501 Magnetic

46899 (LBL–26455, pp. 5) **Magnetization reversal in nucleation-controlled magnets. 1. Theory.** Ramesh, R.; Srikrishna, K. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A statistical model, based on earlier models of Brown and McIntyre, has been developed to examine the magnetization reversal of domain-wall nucleation-controlled permanent magnets such as sintered Fe-Nd-B and $SmCo_5$. Using a Poisson distribution of the defects on the surface of the grains, a weakest link statistics type model has been developed. The model has been used to calculate hysteresis loops for sintered Fe-Nd-B type polycrystalline magnets. It is shown that the intrinsic coercivity measured for a bulk magnet

should vary inversely as the logarithm of the surface area of the grain. The effect of demagnetizing field has been incorporated by a mean-field-type approximation, to calculate the overall nucleation field from the intrinsic coercivity. The theoretically calculated hysteresis loops are in excellent agreement with the overall form of those experimentally determined for similar nucleation-controlled magnets. The model also predicts that for an inhomogeneous grain-size distribution, such as a bimodal distribution, kinks will be observed in the second quadrant of the hysteresis loops.

46900 (LBL–26455, pp. 6) **Magnetization reversal in nucleation-controlled magnets. II. Effect of grain size and size distribution on intrinsic coercivity of Fe-Nd-B magnets.** Ramesh, R.; Thomas, G.; Ma, B.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Results of experiments to study the effect of grain size and grain-size distribution on the intrinsic coercivity and the hysteresis loop of sintered Fe-Nd-B magnets have been obtained. It is shown that the intrinsic coercivity decreases as the average grain size of the magnet is increased. It is also shown that the intrinsic coercivity decreases linearly with the logarithm of the square of the grain size. This is consistent with the predictions made based on the statistical model developed in abstract 1. An increase in the sintering temperature leads to an increase in the average grain size, which consequently leads to a narrower hysteresis loop and lower intrinsic coercivity compared to magnets sintered at a lower temperature. It is also shown that a heterogeneous grain-size distribution, such as a bimodal distribution, causes kinks to appear in the second quadrant of the hysteresis loop. By examining magnets with different fractions of large grains, the prediction that the magnitude of the kinks increases with the volume fraction of the large grains was verified experimentally.

2506 Thermal

Refer also to citation(s) 46967, 47073

2509 Batteries

Refer also to citation(s) 46794, 46961, 47111, 47344, 47345, 47346

46901 (LBL–28515) **Corrosion, passivity and breakdown of alloys used in high energy density batteries: Final report.** Kruger, J. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Materials Science and Engineering). Lawrence Berkeley Lab., CA (USA); Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Materials Science and Engineering. Jan 1990. 49p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016648. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The role of passive films in aqueous solutions has been studied extensively, yet the passivity of metals and alloys in non-aqueous solutions has received comparatively little attention despite its importance to such technologies as lithium batteries, chemical processing, and fuel processing. Long term integrity depends on the protective ability of the passive film in the non-aqueous electrolytes employed. By understanding the nature of passivity in non-aqueous solvents, and factors which cause its breakdown, improvements in the corrosive behavior of structural alloys and electrode materials in lithium batteries and other commercial applications in non-aqueous solutions can be made. The overall objective of this work is to enhance the understanding of the major processes affecting corrosion in non-aqueous solvents: passivity and breakdown of passivity. Since passive layers control corrosion, the achievement of such an understanding especially in regards to how alloys composition affects these layers is crucial to the development of alloys more corrosion resistant in non-aqueous solvents. This research addresses the following fundamental questions: (1) Are the films found in organic solvents different from those produced in aqueous environments: (2) Can passive layers form on bare metals in the absence of water, and if they can, what is their nature? (3) What are the kinetics of passive film formation, breakdown and repassivation? This report presents the findings and pertinent conclusions for Year III of this program (August 1, 1988 to July 31, 1989). 34 refs., 25 figs.

46902 (LBL–29138) **Corrosion-resistant coatings for high-temperature high-sulfur activity applications: Final report.** Selman, J.R. (Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering). Lawrence Berkeley Lab., CA (USA); Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering. Jun 1990. 18p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016638. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The research described in this report is intended to assist in developing the technology for the production of molybdenum, molybdenum carbide and titanium nitride coatings. These coatings have the potential to serve as an alternative to present methods of protecting the metal parts, at positive potential, of high-temperature sulfur or sulfide batteries (e.g., chromizing). This research project was prompted by the observation that only very few materials are corrosion resistant in a high-temperature high-sulfur-activity environment containing polysulfide or FeS_2. Among these materials only molybdenum has really satisfactory corrosion resistance. In LiCl-KCl eutectic containing FeS_2, titanium nitride has also shown adequate corrosion resistance. In polysulfide melts chromium shows good corrosion resistance, and chromizing is presently used to protect the internal surface of the containers in the sodium-sulfur battery, as manufactured at Chloride Silent Power Ltd. It should be noted that the issue of an optimal coating for the sodium-sulfur battery container is somewhat clouded and may be resolved satisfactorily only when there is more information about the effect of very small amounts of dissolved metal, such as chromium or molybdenum, on the life of the sodium-beta-alumina electrolyte. Nevertheless, there is a clear incentive for exploring molybdenum, or molybdenum derivatives, and titanium nitride as alternative protecting materials. 8 refs., 11 figs.

46903 **Novel air electrode for metal-air battery with new carbon material and method of making same.** Ross, P.N. Jr. To Dept. of Energy, Washington, DC (USA). USA Patent 4,927,718/A/. 22 May 1990. Filed date 21 Jun 1988. USA Patent Application 7-209,397. Int. Cl. H01M 4/86. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a novel carbonaceous electrode support material characterized by a corrosion rate of 0.03 wt. %/hour r less when measured a5 550 millivolts vs. a Hg/HgO electrode in a 30 wt. % KOH electrolyte a5 30° C. The electrode support material comprises a preselected carbon black material which has been heat-treated by heating the material to a temperature of from about 2500° to about 3000° C. over a period of from about 1 to about 5 hours in an inert atmosphere and then maintaining the preselected carbon black material at this temperature for a period of at least about 1 hour, and preferably about 2 hours, in the inert atmosphere. A carbonaceous electrode suitable for use as an air electrode in a metal-air cell may be made from the electrode support material by shaping and forming it into a catalyst support and then impregnating it with a catalytically active material capable of catalyzing the reaction with oxygen at the air electrode of metal-air cell.

29 ENERGY PLANNING AND POLICY

46904 (NEDO-P–8937) **On-site survey to gather information on energy policies in the countries of Pacific region.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 103p. (In Japanese). Order Number DE90517227. Source: NTIS (US Sales Only), PC A06/MF A01.

On-site survey was carried out to gather information regarding energy policies, in particular those relevant to electric power, in the countries of the Pacific region. Taiwan is dependent on import for most of its energy. The basis of its energy policies is to develop alternative energy source to oil, to participate in oil development projects abroard and to save energy. Taiwan is very active in promoting nuclear and coal-fired power generation systems. Soair and tidal power generations seem to be difficult. Singapore depends entirely on import for its energy requirement but being the biggest oil terminal in Asia, it is relatively less vulnerable in securing energy

supply. Energy policy is in the hands of private sector and the use of natural gas and coal is considered for power generation. Solar energy is rich. Republic of Korea depends also on import. The share of oil is 46% but the policy is to change fuel to nuclear power and coal. Australia is a major exporter of primary commodities in the world and self-sufficient in all energy except for oil. Power generation is based on coal firing but active for the development of wind power and wave power generation systems. 24 figs., 62 tabs.

46905 Department of Energy announces plans to develop a National Energy Strategy. *Journal of the Air and Waste Management Association (USA),* 39(9): 1232-1233 (Sep 1989).

Secretary of Energy James D. Watkins announced on July 26 the Department of Energy's plans to solicit views and begin the consensus-building process necessary to develop a National Energy Strategy (NES). President Bush has directed the department to develop the National Energy Strategy, an action plan to provide the United States with adequate supplies of clean, competitively priced energy into the future. As part of the process to develop the strategy, DOE plans to conduct a series of public hearings, with an initial hearing scheduled for August 1. Additional regional hearings will be held to solicit comments on a wide range of energy issues and recommended solutions. The National Energy Strategy will guide the U.S. in achieving ample supplies of competitively priced energy in a manner sensitive to the environment, security, and health needs of the American public. When completed, this strategy will contain specific short-term, medium-term, and long-term recommendations, and will be updated on an annual basis. A preliminary draft of the National Energy Strategy will be available in April 1990. Following are excerpts from a DOE summary of plans to develop the NES.

2901 Energy Analysis and Modeling

Refer also to citation(s) 46968

46906 (NEDO-P–8925) **Econometric analysis on oil-substituting energy.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 294p. (In Japanese). Order Number DE90517222. Source: NTIS (US Sales Only), PC A13/MF A01.

The objective of this analysis is to elucidate the final use of energy consumption, add demand analysis model and new energy introduction model, based on that elucidated use, with economic analysis model and new energy cost analysis model, newly developed, and measure, through simulation, oil-substituting energy policy in quantitative effect. CO_2 was also analyzed and predicted in emission quantity. As a result of simulation for the years 1989 through 2030, if both heightening in price for existing energy and new energy techmology breakthrough simultaneously occur, new energy is indicated to be able to become important energy source together with natural gas and nuclear energy. While oil share is partially replaced by different kinds of such new energy and nuclear energy to reduce, in case of low growth, the degree of dependence on oil to 38.8%. Result showed that, if new energy introduction proceeds, CO_2 is at the same level as that at present in emission quantity. 54 figs., 73 tabs.

2902 Economics and Sociology

Refer also to citation(s) 46480, 46481, 46482, 46483, 46489, 46613, 46752, 46916, 46924, 46925, 46931, 46941, 46945, 46947, 46963, 47086

46907 Energy for the long term: mobilization or laissez-faire?. Bourrelier, P.-H. (Houilleres du Bassin du Centre y du Midi (France)); Tour, X.B. de la; Lacour, J.-J. *Revue de l'Energie (France),* 41(418): 81-117 (Feb 1990). (In French).

The authors explain the methodology with which we can evaluate the present and future costs of delivery on the world market of mineral fuels (oil, natural gas, coal, uranium), coming from limited natural resources. These costs depend upon a mobilization of resources which affects prospecting, technical research applied to improvement of methods for extraction prospecting and transportation, and the adapting of production and distribution capacities. Forecasts until 2050 are presented for the four fuels considered, separately and overall. They are supplemented by indications concerning new and renewable energies whose future cost and potential are however difficult to tie down. The evolution in the marginal costs which result from these forecasts and the evolution of the use restrictions, justified by the protection of the environment, then determine the long term price trends and the probable substitutions based upon energy consumption scenarios. These scenarios themselves depend upon prices so we can then test the overall coherence of the developments expected and realize that only a very moderate long term energy consumption growth would be compatible with the various restrictions. The study shows that resources are not expected to fall short but that certain energy prices are expected to increase considerably. The market will depend upon the efficiency with which technical progress will be used to compensate the contradiction between natural limits and demographic growth. This is the broader sense given by the authors to the idea of mobilization in the three fields, i.e. production, waste elimination, consumption savings. The authors insist upon the dangers of stock-outs which would become aggravated if this triple mobilization, working at various future points in time, would not suffice. 23 refs., 28 figs., 7 tabs.

46908 Energy, the environment, and the economy. Davis, W.K. *International Atomic Energy Agency Bulletin (Austria),* 32(1): 44-48 (1990).

The principal energy questions addressed by the 14th World Energy Congress and discussed in this paper, were: Does the world have adequate economic energy resources to support the socio-economic needs of both the developing and the industrialized countries? Are energy resources in the forms needed available at reasonable prices to all countries wanting them? Will research and development produce new energy supply options and more efficient use of energy - and when will such development be likely to be applied on a significant scale? Can energy be produced, transported, and used in an environmentally acceptable manner and at cost which allow for economic health and growth?.

2903 Environment, Health, and Safety

Refer also to citation(s) 46480, 46481, 46482, 46483, 46670, 46683, 46822, 46908, 46918, 46926, 46941, 46964, 47072, 47504, 47509, 47534, 47535, 47536, 47537, 47549, 47552, 47620, 47693

46909 (BNL–52256) **Action plan for the Tiger Team assessment report.** Brookhaven National Lab., Upton, NY (USA). 30 Aug 1990. 512p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC02-76CH00016. Order Number DE90017350. Source: NTIS, PC A22/MF A01 - OSTI; GPO Dep.

This document contains responses and planned actions that address the findings of the Tiger Team Assessment of Brookhaven National Laboratory, June 1990. In addition, the document contains descriptions of the management and organizational structure to be used in conducting planned actions, root causes for the problems identified in the findings, responses, planned actions, schedules and milestones for completing planned actions, and, where known, costs associated with planned actions.

46910 (DOE/IG–0287) **Credits due the Department of Energy for funding high-level nuclear waste management research and development.** USDOE Office of Inspector General, Albuquerque, NM (USA). Western Regional Office. 8 Aug 1990. 10p. Sponsored by U.S. DOE Office of Inspector General. Source: OSTI (Free of Charge).

Report to The Secretary.

High-level nuclear waste has accumulated in large quantities as a result of nuclear operations by both civilian and federal entities. The Nuclear Waste Policy Act of 1982 (Act), Public Law 97–425, created the civilian high-level radioactive waste repository program, a comprehensive national program for the safe management, storage, and permanent disposal of highly radioactive nuclear waste in deep underground repositories. The Office of Civilian Radioactive Waste Management (OCRWM) in the Department of Energy (Department) was responsible for managing the program. As primary beneficiaries, the civilian electric utility companies and the Department were required to pay for the activities authorized by the Act.

Neither the taxpayer paying or high-level waste disposal nor the ratepayers of electric utilities paying for spent nuclear fuel disposal were intended to subsidize one another. The objective of this audit was to determine whether the Department had identified federal activities and associated costs that benefited the high-level nuclear waste disposal program and, therefore, would qualify as credits against federal payments into the Nuclear Waste Fund.

46911 (ETSU-R-54) **Options for mitigating the greenhouse effect.** Currie, Ken (Energy Technology Support Unit, Harwell (UK)). Department of Energy, London (UK); Energy Technology Support Unit, Harwell (UK). Apr 1989. 14p. Order Number DE90519511. Source: NTIS (US Sales Only), PC A03/MF A01.

The global perspective on the greenhouse gases and climate change and the more parochial question of what we in the UK might actually do to reduce emissions are examined. International agreement on concerted action, along the lines of the Toronto Conference, is discussed, where it was suggested that it would be necessary to cut emissions by 50% or more. What all this boils down to is that, under these hypothetical circumstances, we would have to cut our emissions of CO_2 from 160 million tonnes of carbon per annum today, to 80 million in 2020. Without action the emissions would go up to 210 million or more, instead we have got to reduce them from that by 130 million tonnes per annum. (author).

46912 (GAO/RCED-90-22) **Superfund: A more vigorous and better managed enforcement program is needed.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Jan 1990. 97p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

Although the federal government has an important financial stake in the success of Superfund enforcement, this report has found that EPA's enforcement efforts have been hampered by delayed and incomplete attempts to find responsible parties, insufficient use of orders to compel recalcitrant parties to begin cleanup operations, growing backlogs of cases where a recovery of federal cleanup costs should be sought, and narrow interpretations of what federal costs are recoverable. A comprehensive management review of Superfund recognized many of the problems discussed in this report and proposed corrective action. However, EPA has not yet acted in two areas that GAO believes are critical to improving enforcement: establishing long-term, measurable goals and determining the resources required to reach these goals.

46913 (GAO/RCED-90-82BR) **Environment, safety, and health: Status of DOE's reorganization of its safety oversight function.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 20p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

In May 1989, the Secretary of Energy announced an organizational and management restructuring plan. Concerns arose that this plan would diminish the independent safety oversight role of DOE's Office of Environment, Safety, and Health by replacing it with internal oversight by line managers and with external review by safety boards. This report provides information on the major events that led to the proposed restructuring and a brief description of the proposed restructuring plan. GAO also provides general observations on the plan.

46914 (SI/R-881008) **Residues from municipal solid waste incineration.** Karstensen, K.H. Senter for Industriforskning, Oslo (Norway). Dec 1988. 37p. (In Norwegian). Order Number DE90518765. Source: NTIS (US Sales Only), PC A03/MF A01.

Residues from two solid waste incineration plants where collected and analysed for elements and extractable organic chlorine. Leaching experiments where performed with the samples and differences in the leachability of lead and zinc was demonstrated, which can be related to the pH in the solutions. 3 figs., 18 tabs., 10 refs.

46915 **Keepin and Kats - a comment.** Kinderman, E.M. (SRI International, Menlo Park, CA (USA)); Schumacher, W.J. *Energy Policy (UK)*, 18(4): 389-394 (May 1990).

We consider the arguments of Keepin and Kats that nuclear power and conservation are mutually exclusive methods of reducing CO_2 emissions from coal-fired electric power generation. In contrast to their approach, we suggest that a combination of nuclear power and conservation can reduce CO_2. Nuclear power is appropriate and economic in some regions. The gradual introduction of equipment and techniques for improving the efficiency of electricity consumption will continue to be made and they will eventually reduce growth in electricity demand. Introducing about 600 GW of nuclear power in 35 years and efficiency improvements that reduce growth in world electricity demand by two-thirds (to an average of 1.5% per year) would hold CO_2 emissions from electric power production to levels similar to today's. (author).

46916 **The contribution of efficient energy pricing to reducing carbon dioxide emissions.** Burgess, J.C. (London Environmental Economics Centre, London (UK)). *Energy Policy (UK)*, 18(5): 449-455 (Jun 1990).

Carbon dioxide (CO_2) emissions from energy utilization are a major factor contributing to the greenhouse effect. Removing existing price distortions and imposing privately efficient energy pricing makes a substantial impact on energy demand. The estimated reduction in CO_2 emissions in the USA, China and India by adopting privately efficient electricity pricing is just less than the UK's total annual emissions of CO_2 from fossil fuel combustion. However, privately efficient pricing does not ensure the optimal social level of energy production that is necessary for averting the greenhouse effect. Further policy instruments and considerations need to be adhered to in order to attain this optimum level globally. 7 refs., 8 tabs.

2904 Energy Resources

Refer also to citation(s) 46741, 46742, 46743, 46908, 46929, 47617

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 46776, 46782, 46791, 46792, 46794, 46967, 46973, 47057, 47060, 47061, 47062, 47075, 47113

46917 (DOE/CE-0294P) **The thirteenth report to Congress: Comprehensive program and plan for federal energy education, extension, and information activities: Annual revisions: Section 508(c), National Energy Extension Service Act, Pub. L. 95-39, 42 U.S.C. 7007(c), and Section 404(2), Energy Security Act, Pub. L. 96-294, 42 U.S.C. 7373.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs. Nov 1989. 66p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE90014838. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The document which follows is the thirteenth annual revision to the Comprehensive Program and Plan for Federal Energy Education, Extension, and Information Activities pursuant to section 508(c) of the National Energy Extension Service Act, Public Law 95-39, 42 USC 7007(c). It also fulfills the requirement under section 404(2) of the Energy Security Act, Public Law 96-294, 42 USC 7373. The report is being submitted to Congress as an addendum to the Department of Energy's budget submission. This revision, like its predecessors, catalogues the coordinating activities between and among the participating federal departments and agencies in the area of federal energy education, extension and information activities. The report is a compendium of current federal energy education, extension, and information activities, and provides a point of contact for additional information. These programs cover a broad range of energy applications, and address many different audiences through a variety of delivery mechanisms, including volunteer efforts, research and development initiatives, and efforts aimed at specific consumers. 2 tabs.

46918 (DOE/S-0010(89)) **The Secretary's annual report to Congress, 1988-1989.** USDOE, Washington, DC (USA). [1989]. 396p. Sponsored by U.S. DOE Office of Administration and Human

Resource Management. Order Number DE90016651. Source: NTIS, PC A18/MF A01 - GPO; OSTI; INIS; GPO Dep.

This is the 10th Annual Report to Congress of the United States Department of Energy, and it covers the years 1988 and 1989. Activities of all elements of the Department are described except those of the independent Federal Energy Regulatory Commission, which issues its own report. 41 refs., 130 figs., 36 tabs.

46919 (DOE/S–0079) **Laboratory-based science education programs: New initiatives.** USDOE Office of Energy Research, Washington, DC (USA). [1990]. 10p. Sponsored by U.S. DOE Office of the Secretary. Order Number DE90015878. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This document consist of nine summaries of recent initiatives taken by National Laboratories to stimulate minority groups for education and careers in scientific and engineering fields. (FSD)

46920 (DOE/S–0080) **Laboratory-based science education programs.** USDOE, Washington, DC (USA). [1990]. 81p. Sponsored by U.S. DOE Office of the Secretary. Order Number DE90015877. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document consist of descriptions from National Laboratories of programs designed to involve their scientific and engineering personnel in assisting both secondary and post secondary educational facilities in the areas of their specific expertise. (FSD)

46921 (NEDO-P–8934) **Commissioned survey report to construct base introducing alternative-energy for oil.: Enetopia island concept. Survey for model to introduce new energy.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 196p. (In Japanese). Order Number DE90517229. Source: NTIS (US Sales Only), PC A09/MF A01.

This report summarized the surveyed results to concrete the Enetopia Island Concept as a part of survey to construct the base introducing alternative energy for oil. New energy group which can soonly put into practical use, is gathered in a determined area and interconnected to the real power supplying system. In this report, Okinawa District was selected as the object to use the model for a isolated island system which is expected as the dispersed power supplying source. A large amount of natural energy exists in Okinawa where is rich for solar radiation and wind energy. In addition, Okinawa has sufficient commercial power supply system. Two areas of Miyako and Yaeyama were finally selected. Solar generation is clean but the solar energy density is small and the conversion rate is low like 15%. It is required to research solar cells so as to make it highly efficient, and manufacture large area solar cells; and further to carry out the demonstrating operation so as to put it into practical use. It is required to lighten the system to make it highly efficient and to develop control technique for the wind farm system in order to develop the wind energy. Any fuel cells is efficient and has high adaptability to any environments but the cost is high and the reliability and life are noy yet verified. 63 figs., 22 tabs.

46922 (SERI/TP–260-3729) **A planning framework for transferring building energy technologies.** Farhar, B.C.; Brown, M.A.; Mohler, B.L.; Wilde, M.; Abel, F.H. Solar Energy Research Inst., Golden, CO (USA). Jul 1990. 183p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000347. Source: NTIS, PC A09/MF A01 - OSTI; GPO Dep.

Accelerating the adoption of new and existing cost-effective technologies has significant potential to reduce the energy consumed in US buildings. This report presents key results of an interlaboratory technology transfer planning effort in support of the US Department of Energy's Office of Building Technologies (OBT). A guiding assumption for planning was that OBT's R&D program should forge linkages with existing programs whose goals involved enhancing energy efficiency in buildings. An ad hoc Technology Transfer Advisory Group reviewed the existing analysis and technology transfer program, brainstormed technology transfer approaches, interviewed DOE program managers, identified applicable research results, and developed a framework that management could use in deciding on the best investments of technology transfer resources. Representatives of 22 organizations were interviewed on their views of the potential for transferring energy efficiency technologies through active linking with OBT. The report describes these programs and interview results; outlines OBT tools, technologies, and practices to be transferred; defines OBT audiences; identifies technology transfer functions and presents a framework devised using functions and audiences; presents some 60 example technology transfer activities; and documents the Advisory Group's recommendations. 37 refs., 3 figs., 12 tabs.

46923 (TKK-NEMO–10) **The summary of the NEMO-research plan for the year 1989.** Lund, P.D. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France)). Helsinki Univ. of Technology, Espoo (Finland). 1989. 38p. (In Finnish). Order Number DE90518690. Source: NTIS (US Sales Only), PC A03/MF A01.

NEMO-Research Programme.

This report summarizes the activity in the year 1988 and presents the main features of the research plan for the year 1989. In the year 1988 the research was emphasized on preliminary studies and surveying works. The work has been progressing well and in the 1989 it is already possible to concentrate the research on particular fields of energy technology like for example on wind energy, heat storage and fuel cells technology.

2906 Nuclear Energy

Refer also to citation(s) 46791, 46907, 46908, 46915, 46918, 46930, 46935, 46942, 47116, 47490, 48026

46924 Nuclear Weapons and Peace: Political challenge and theological controversy in West German Protestantism. Rendtorff, T. (Inst. for Systematic Theology, Univ. of Munich (DE)). pp. 138-157 of Ethics in the nuclear age: Strategy, religious studies and the churches. Whitmore, T. Southern Methodist University Press, Dallas, TX (USA) (1989).

This paper presents a discussion between theological ethicists and politicians. The points of discussion are described. The issue of German reunification consequences is addressed.

46925 Reason and authority in church social documents: The case for plausibility and coherence. Whitmore, T. (Univ. of Chicago, IL (US)). pp. 181-231 of Ethics in the nuclear age: Strategy, religious studies and the churches. Whitmore, T. Southern Methodist University Press, Dallas, TX (USA) (1989).

This paper presents the argument that the complex nature of modern public life in general and the problem situation of the possession and potential use of nuclear weapons in particular require religious institutions to reconsider their understanding of the reason and authority of their social documents. Description, construction and evaluation of the model are reported.

46926 The world's energy needs and the nuclear power option. Blix, H. (International Atomic Energy Agency, Vienna (Austria)). *International Atomic Energy Agency Bulletin (Austria),* 32(1): 38-43 (1990).

In the context of energy needs for developing countries and of environmental concerns, the role of nuclear energy is discussed. The prospects for the future of nuclear power are presented with respect to the main arguments against: the increase of the risk of proliferation of nuclear weapons, the risk of accidents with serious consequences, the waste problem and its irrelevance to the greenhouse problem.

46927 Safety of future nuclear installations: An overview. Anderer, J. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety). *International Atomic Energy Agency Bulletin (Austria),* 32(1): 53-56 (1990).

From discussions at a recent workshop on nuclear plant safety sponsored by the IAEA and Argonne National Laboratory (ANL) in the United States, it was clear that most experts expect nuclear power to be deployed globally on a larger scale over the next few decades. Several explanations were given for this cautious optimism. Many believe that the increasing concerns voiced by scientists, politicians, and the public about fossil fuel combustion and the threat to the environment posed by climate warming, stratospheric ozone depletion, and acid rain have prompted these groups to think again about the circumstances under which nuclear power might be part of an environmentally sustainable energy strategy, Others argue that the accelerating demand for energy

and for electricity in particular, together with increasing societal awareness of the economic and lifestyle problems associated with every significant source of energy service (energy efficiency inclusive), will gradually lead people to opt for an energy mix that includes nuclear power.

2908 Heat Utilization

Refer also to citation(s) 46782

2910 Conservation

Refer also to citation(s) 46915, 46917, 46918, 46922, 46933, 46944, 46967, 46973, 47072, 47081, 47086, 47094

46928 (DOE/CE–0293P) **Annual report to the President and the Congress on the State Energy Conservation Program for calendar year 1988.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs. Oct 1989. 13p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE90014849. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An Annual Report to the President and the Congress on the State Energy Conservation Program (SECP) is required to be prepared and transmitted annually by section 365(c) of the Energy Policy and Conservation Act (EPCA), Public Law 94-163, 42 USC 6325(c). This is the thirteenth annual report; it discusses program activities from January 1 through December 31, 1988. For FY 1988, all states developed and implemented plans that were approved by their respective USDOE Operations/Support Offices. In their plans the states were able to design conservation programs that complied with the requirements of the legislation and at the same time were compatible with state and local needs. 4 tabs.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 46907, 46942

46929 (DOE/EIA–0202(90/1Q)) **Short-term energy outlook: Quarterly projections, January 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 2 Feb 1990. 55p. Sponsored by U.S. DOE Management & Administration. Order Number DE90016013. Source: NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration (EIA) quarterly forecasts of short-term energy supply, demand, and prices are revised in January, April, July, and October for publication in the Short-Term Energy Outlook (Outlook). An annual supplement analyzes previous forecast errors, compares recent projections by other forecasters, and discusses current topics of the short-term energy markets (see Short-Term Energy Outlook: Annual Supplement, DOE/EIA-2020). The principal users of the Outlook are managers and energy analysts in private industry and government. The projections in this volume extend through the fourth quarter of 1991. The forecasts are produced using the Short-Term Integrated Forecasting System (STIFS). The STIFS model is driven principally by the following sets of assumptions or inputs: forecasts of key macroeconomic variables, a particular set of world oil price assumptions, and assumptions about the severity of weather. Macroeconomic forecasts are produced by DRI/McGraw-Hill. EIA's Oil Market Simulation Model is used to project world oil prices. (The EIA models are available on computer tape and diskette from the National Technical Information Service.) The three featured projections for petroleum supply and demand are based on low, middle, and high economic growth assumptions coupled with high, middle, and low crude oil price trajectories, respectively, and various weather scenarios. The extreme weather cases are designed to replicate, quarter by quarter, the most severe weather conditions witnessed since 1975. The discussion and tables in this volume refer primarily to the middle, or base case, scenario and, unless otherwise noted, to the domestic situation. Table 7 summarizes the petroleum sensitivity cases and indicates the estimated effect of price, macroeconomic conditions, and weather on petroleum demand. 19 refs., 18 figs., 17 tabs.

46930 **World electricity generation, nuclear power, and oil markets.** *International Atomic Energy Agency Bulletin (Austria)*, 32(1): 31-37 (1990).

Striking changes have characterized the world's production and use of energy over the past 15 years. Most prominent have been the wide price fluctuations, politicization of world oil prices and supply, along with profound changes in patterns of production and consumption. This report, based on a study by energy analysts at Science Concepts, Inc., in the United States, traces changes in world energy supply since 1973-74 - the time of the first oil "price shocks". In so doing, it identifies important lessons for the future. The study focused in particular on the role of the electric power sector because the growth in fuel use in it has been accomplished without oil. Instead, the growth has directly displaced oil. In the pre-1973 era, the world relied increasingly on oil for many energy applications, including the production of electricity. By 1973, more than on-fourth of the world's electricity was produced by burning oil. By 1987, however, despite a large increase in electric demand, the use of oil was reigned back to generating less than 10% of the world's electricity. Nuclear power played a major role in this turnaround. From 1973-87, analysts at Science Concepts found, nuclear power displaced the burning of 11.7 billion barrels of oil world-wide and avoided US $323 billion in oil purchases.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 46912, 46918, 46928, 46929

46931 (GAO/NSIAD–90-131) **DOD budget: Status of Five-Year Defense Plan.** General Accounting Office, Washington, DC (USA). National Security and International Affairs Div. Mar 1990. 4p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report supplements the information provided in GAO's February 22, 1990, report on DOD's Five- Year Defense Plan. The Conference report on the fiscal year 1988-89 DOD Authorization Act explained that DOD was to show in detail how its plans for the outyears of the five-year period would be affected by the enactment of the aggregate obligational authority for those years set forth in the President's budget. The conferees expected that the Five- Year Defense Plan submissions would be at the same level of detail as the fiscal years 1988 and 1989 budget submissions, together with the associated construction; procurement; and research, development, test, and evaluation annexes. While DOD has submitted budgetary information on planned reductions for fiscal years 1992-94, DOD believes that, given the level of uncertainty in the current international situation, it is not possible to submit a Five-Year Defense Plan that complies with the law. This report agrees with DOD that the information submitted to date is not the submission contemplated by the law.

46932 (LBL–25077) **Energy emergency preparedness: An overview.** Barnes, B.K.; Rothkopf, M.H. Lawrence Berkeley Lab., CA (USA). Jun 1988. 106p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC03-76SF00098. Order Number DE90016628. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Energy emergency preparedness is the special responsibility of the Deputy Assistant Secretary of Energy Emergencies within the Office of the Assistant Secretary for International Affairs and Energy Emergencies; though other Department of Energy (DOE) offices manage some aspects and DOE also coordinates emergency management with other federal departments. There are two basic objectives for energy emergency preparedness. The first of these, the economic stabilization objective, seeks to ease the impact of an energy supply disruption by facilitating a quick recovery and minimizing the disruption's economic consequences. The second is the mobilization support objective to ensure that there is adequate energy and fuel to support defense, defense industrial and critical civilian needs for energy and fuel. While all energy systems are vulnerable they vary in the degree of seriousness and the probability of a disruption. Oil is the most vulnerable, and will become increasingly so in the 1990's, as domestic and reliable foreign sources diminish and the United States relies more on imports from volatile Persian Gulf countries. Electric power is the next most

vulnerable system, being open particularly to multi-site terrorist attack. This overview examines two highly connected organizations: the Office of Energy Emergencies (OEE) itself and the actual response organization, centering on the Energy Emergency Management System (EEMS). 38 refs., 10 figs.

46933 (LBL–27295) **A long-term perspective on Norwegian energy use.** Schipper, L.; Howarth, R.; Wilson, D. Lawrence Berkeley Lab., CA (USA). May 1990. 57p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90014887. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Norway is the home country of the leader of Brundtland Commission, which recommended that nations reduce their energy use through increased energy efficiency. In order to better understand the potential for such a reduction in Norway, the Norwegian Oil and Energy Department, along with Oslo Lysvaerker, asked the International Energy Studies Group at the Lawrence Berkeley Laboratory to analyze the changes in the level and structure of Norwegian energy demand that have developed since 1950. The long time horizon of our analysis allowed us to examine the evolution of the energy use of each major sector of the economy. The results of our analysis show that energy efficiency has not improved as much in Norway as in other countries since 1973. Two factors lie behind this finding. First, electricity and wood have been cheap and abundant in Norway, and oil, although priced for international markets, has not been perceived as a scarce fuel. Indeed, the burgeoning revenues from the oil sector provided Norwegians with access to more cars and more travel, larger and more comfortable homes, and other amenities so that energy use increased even after 1973 while the citizens of other nations were cutting back on energy use. The second, more subtle factor, is that the use of energy in Norway reached maturity only quite recently, as the ownership of the principal energy-using equipment of each sector began to approach saturation. The maturation of energy demand in Norway implies that the significant potential for energy resource conservation can now be exploited. If energy prices should rise significantly in Norway, we expect that the energy efficiency of the Norwegian economy could improve dramatically in the future. 39 refs., 37 figs.

2940 Fossil Fuels

Refer also to citation(s) 46474, 46475, 46480, 46481, 46482, 46483, 46489, 46582, 46583, 46613, 46907, 46918, 46929, 46932, 46933, 46942

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 46751, 46752, 46946

2960 Electric Power

Refer also to citation(s) 46792, 46794, 46818, 46822, 46894, 46929, 46930, 46932, 46933, 46942, 46945, 46963

46934 (CONF-9010174–1) **A bright future for electric-utility DSM [demand-side management] programs.** Hirst, E. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From Enhancing electricity's value to society; Toronto (Canada); 22-24 Oct 1990. Order Number DE90015798. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper expounds on the advantages of using Demand Side Management (DSM) between now and the year 2010. Electric power demand is expected to grow more slowly than the gross national product; organization, customer service, and management are projected to be of increasing importance. 8 refs., 7 figs. (FSD)

46935 (DOE/EIA–0455(88)) **Electric plant cost and power production expenses, 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 16 Aug 1990. 152p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90015997. Source: NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

This document is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels (CNEAF); Energy Information Administration (EIA); US Department of Energy. From 1982 through 1987 this report was titled Historical Plant Cost and Annual Production Expenses for Selected Electric Plants. This publication presents electric utility statistics on power production expenses and construction costs of electric generating plants. Data presented here are intended to provide information to the electric utility industry, educational institutions, federal, state, and local governments, and the general public. These data are collected and published to fulfill data collection and dissemination responsibilities of the Energy Information Administration (EIA), as specified in the Federal Energy Administration Act (Public Law 93-275), as amended. This 1988 edition is a modified version of the historically published reports. For a description of predecessor publications, see the "Predecessor Publications" section of the Technical Notes (Appendix F). 7 figs., 20 tabs.

46936 (EPRI-EL–6926-Vol.1) **Development of a composite system reliability evaluation program: Volume 1, Methodology and project results: Final report.** Pereira, M.V.F. (Power Systems Research, Inc., New York, NY (USA)); Pinto, L.M.V.G.; Mazumdar, M.; Yengar, S.I. Electric Power Research Inst., Palo Alto, CA (USA); Power Systems Research, Inc., New York, NY (USA); Pittsburgh Univ., PA (USA). ©Aug 1990. 82p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes the methodology and computational results of a new composite reliability evaluation tool, CREAM. The methodology is based on Monte Carlo sampling of equipment availability (generators and circuits, including weather-dependent and common-cause or dependent outages) and load level (including system load or bus load vector scenario). The analysis of a samples scenario is based on the linearized power flow model. Remedial actions and load curtailment are carried out by an efficient linear programming routine. Besides calculating adequacy indices (LOLP and EPNS) both at system and bus levels, the program produces the sensitivity of the reliability indices with respect to incremental reinforcements of generation capacities and circuit capacities. The required number of Monte Carlo samples is reduced through a new variance reduction technique, which uses analytical models (such a single-bus generation capacity reliability model) as a "regression variable." The component of reliability indices "explained" by these variables is then "factored out" of the Monte Carlo sampling scheme. The program is demonstrated in case studies with two 500-bus utility-derived test systems. 17 refs., 10 figs., 18 tabs.

46937 (EPRI-EL–6926-Vol.2) **Development of a composite system reliability evaluation program: Volume 2, Mathematical models and computational aspects: Final report.** Pereira, M.V.F. (Power Systems Research, Inc., New York, NY (USA)); Pinto, L.M.V.G.; Mazumdar, M.; Yengar, S.I. Electric Power Research Inst., Palo Alto, CA (USA); Power Systems Research, Inc., New York, NY (USA); Pittsburgh Univ., PA (USA). ©Aug 1990. 85p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes in detail the mathematical models and techniques used in the development of a new composite reliability evaluation tool, CREAM. The methodology is based on Monte Carlo sampling of equipment availability (generators and circuits, including weather-dependent and common-cause or dependent outages) and load level (including system load or bus load vector scenario). The analysis of a sampled scenario is based on the linearized power flow model. Remedial actions and load curtailment are carried out by an efficient linear programming routine. Besides calculating adequacy indices (LOLP and EPNS) both at system and bus levels, the program produces the sensitivity of the reliability indices with respect to incremental reinforcements of generation capacities and circuit capacities. The required number of Monte Carlo samples is reduced through a new variance reduction technique, which uses analytical models (such a single-bus generation capacity reliability model) as a "regression variable." The component of reliability indices "explained" by these variables is then "factored out" of the Monte Carlo sampling scheme. The program

is demonstrated in case studies with two 500-bus utility-derived test systems. 12 refs., 1 fig., 7 tabs.

46938 (EPRI-EL–6926-Vol.3) **Development of a composite system reliability evaluation program: Volume 3, User manual and installation notes: Final report.** Pereira, M.V.F. (Power Systems Research, Inc., New York, NY (USA)); Pinto, L.M.V.G.; Mazumdar, M.; Yengar, S.I. Electric Power Research Inst., Palo Alto, CA (USA); Power Systems Research, Inc., New York, NY (USA); Pittsburgh Univ., PA (USA). ©Aug 1990. 52p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes the input data format and installation details of a new composite reliability evaluation tool, CREAM. The methodology is based on Monte Carlo sampling of equipment availability (generators and circuits, including weather-dependent and common-cause or dependent outages) and load level (including system load or bus load vector scenario). The analysis of a sampled scenario is based on the linearized power flow model. Remedial actions and load curtailment are carried out by an efficient linear programming routine. Besides calculating adequacy indices (LOLP and EPNS) both at system and bus levels, the program produces the sensitivity of the reliability indices with respect to incremental reinforcements of generation capacities and circuit capacities. The required number of Monte Carlo samples is reduced through a new variance reduction technique, which uses analytical models (such a single-bus generation capacity reliability model) as a "regression variable." The component of reliability indices "explained" by these variables is then "factored out" of the Monte Carlo sampling scheme. The program is demonstrated in case studies with two 500-bus utility-derived test systems.

46939 (EPRI-EM–5906) **Data collection for CLASSIFY™ and PULSE: Final report.** Lineweber, D. (National Analysts, Inc., Philadelphia, PA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); National Analysts, Inc., Philadelphia, PA (USA). ©Aug 1990. 259p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Customer Preferences and Behavior (CP&B) Project is designed to satisfy two chief objectives of electric utility managers concerned with demand-side management (DSM): organize utility customers into submarkets or segments on the basis of their energy-related needs; and provide tools for evaluating and targeting DSM program options. As part of the CP&B project, a national residential survey of residential customers was conducted, from which two software tools were developed: CLASSIFY™ to segment residential customers; and PULSE to evaluate and target DSM program options. This guidebook provides a detailed description of the 1988 CP&B National Residential Survey and suggests how member utilities can make use of the resulting CP&B national database and software (CLASSIFY™ and PULSE) in their market planning activities. 38 figs.

46940 (LBL–23780) **Least-cost planning for Pacific Gas and Electric: Stage 2, Case studies.** Kahn, E.; Comnes, G.A.; Pignone, C.; Warren, M. Lawrence Berkeley Lab., CA (USA). 14 Dec 1987. 117p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016644. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This project is an attempt to evaluate the usefulness of mainframe electric utility planning models for conducting least-cost planning (LCP). In the project's first stage, the Load Management Strategy Testing Model (LMSTM), written by Decision Focus, Inc. (DFI) for the Electric Power Research Institute (EPRI) (DFI, 1982, 1984, 1985), was calibrated to the Pacific Gas and Electric Company (PG&E) system. The calibration attempted to replicate PG&E as portrayed in the company's 1985 Long Term Plan (LTP) (Kahn et al., 1987), in the company's previous LMSTM input files, and in other data sources provide by PG&E. The attraction of LMSTM rests on its being an integrated model that attempts to solve the whole planning problem simultaneously. Only if the whole system is modeled as one organic entity can perturbations on opposite sides of the planning problem be compared. The stage 1 report describes the LMSTM calibration process in detail and discusses many of the issues and problems involved in LCP. In this, the second stage of the project, the stage 1 calibration is updated to incorporate more recent company information. This modified calibration is used as the "base case" against which some modest test cases are evaluated using LMSTM and other computer models, which solve parts of the problem exogenously to LMSTM. In general, the approach of the case study is to specify a demand-side program using data from PG&E and exogenous sources, to observe how this program would change the use of supply-side resources in the planning horizon (1989–2003), and then, to make a supply-side adjustment, based entirely on the judgment of the modeler, that seems to be the best cost-saving alternative available. 37 refs., 26 figs., 20 tabs.

46941 (LBL–28616) **A survey of state PUC [Public Utility Commission] activities to incorporate environmental externalities into electric utility planning and regulation.** Cohen, S.D. (Lawrence Berkeley Lab., CA (USA)); Eto, J.H.; Goldman, C.A.; Beldock, J.; Crandall, G. Lawrence Berkeley Lab., CA (USA). May 1990. 106p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016630. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The environmental effects that accompany operation of electric generating plants have significant impacts on society. In 1985, electricity production from fossil-fired facilities accounted for about two-thirds of the SO_2 and about one-third of the NO_x and CO_2 emitted in the US SO_2 and NO_x are precursors to acid rain, which causes serious damage to forests, lakes, and agriculture. In addition, many electric supply options cause water pollution and land contamination, even after complying with current state and federal environmental regulations. Damage costs from water and land environmental impacts appear to be much less than damage estimates caused by air pollutants, but are still quite significant. Partly in response to increased public concern about the impacts of acid rain and global climate change, regulatory commissions in many states are now granting with difficult questions of how to include environmental externalities in utility resource planning. It is also clear that concern about the environmental costs of electricity generation is one of the driving forces for many Public Utility Commissions (PUC) in placing increased emphasis on demand reduction alternatives for utilities. This survey represents a snapshot of current practices in a rapidly changing area. There is a wide range of awareness of this subject by PUCs and it appears that, to some extent, PUCs have proceeded independently of one another. This report is organized in several sections following this introduction. In the next section, we summarize the survey questions and the approach we used to analyze PUC responses. Section 3 summarizes the results of the survey, which are reported in detail for each state in Appendix A. We then discuss limitations in the study, given the scope, available resources and time frame, identify areas for future work. 16 refs., 2 figs., 5 tabs.

2980 Consumption and Utilization

Refer also to citation(s) 46929, 46963, 46976

46942 (DOE/EIA–0035(90/05)) **Monthly energy review, May 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 24 Aug 1990. 135p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. Order Number DE90015988. Source: NTIS, PC A07/MF A01 - GPO; OSTI; INIS; GPO Dep.

This document is a monthly report of Energy Information Administration on production, consumption, stocks, imports, and prices of the principal energy commodities in the United States. International energy data is also presented. 47 figs., 67 tabs. (FSD)

46943 (ETLA–316) **Defining energy conservation.** Kasanen, P. Research Inst. of the Finnish Economy, Helsinki (Finland). 1990. 58p. (In Finnish). Order Number DE90518713. Source: NTIS (US Sales Only), PC A04/MF A01.

Discussion papers.

The purpose of this study is to analyze the concept of energy conservation and to suggest guidelines for the definition of the concept and the terms to be used. In the first part of the study we

outline the problem by dividing changes in the level of energy conservation into three components: changes in the level of energy using activities i.e. the utility received by the consumer, the efficiency of energy consumption and changes in the structure of the economy. Changes in energy conumption originate in numerous direct and indirect decisions. In the second part of the study we analyze definitions of energy conservation and the related teminology. The definitions cover the following ways of thinking about energy conservation: the differences between trend development and conservation, influencing the level of energy using activity, improving the energy efficiency of energy using activities, energy impacts of the structural change of the economy, conservation from the point of view of an energy utility and conservation according to general equilibrium theory. We conclude by making suggestions as to the use of the terms. It is essential to define the goal motivating energy conservation. It is not possible to avoid defining some terms for each specific case even if one of the suggested alternative definitions for the term conservation is chosen.

46944 (LBL–24306) **Technical documentation for a residential energy use data base developed in support of ASHRAE Special Project 53.** Huang, Y.J.; Ritschard, R.; Bull, J. Lawrence Berkeley Lab., CA (USA). 10 Nov 1987. 261p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098 ;AC06-76RL01830. Order Number DE90016624. Source: NTIS, PC A12/MF A01 - OSTI; GPO Dep.

Starting in 1986, Pacific Northwest Laboratory (PNL) has been working with ASHRAE Special Project 53 to conduct research in support of a residential energy conservation standard. The Energy Analysis Program at Lawrence Berkeley Laboratory (LBL) has been contracted by PNL to develop a new residential energy use data base in support of this effort. The simulation methodology improves upon that used earlier by LBL in producing the voluntary energy guidelines data base. Significant enhancements were made in the modeling of underground heat flow, window operations and glazing types, and cooling loads. Since the proposed standards will be in a computerized format, the final data base was tailored to utilize the capabilities of a micro-computer program. The residential energy use data base was developed using the DOE-2.1C building energy simulation program and covers three building prototypes (one-story, townhouse, and apartment), three foundation conditions (slab-on-grade, basement, and vented crawl space) in 45 US locations. For each building prototype and location, a range of insulation, infiltration, and window conditions were considered. The calculated annual heating and cooling loads were analyzed and reduced to regression coefficients giving the contribution to building load of each component, i.e., ceiling, walls, infiltration, as a function of its thermal and physical characteristics. The primary format of the data base is a computer file of regression coefficients coded by prototype, location, building component, and separated by heating or cooling. The same information is also available in printed form on tables that also show the incremental changes in heating and cooling loads for typical conservation measures. The data base serves as the building loads calculation portion of the computer program being developed by PNL as a residential conservation standard. 16 refs., 35 figs., 11 tabs.

46945 (LBL–28762) **Electricity consumption and structural change in manufacturing industry in developing countries.** Meyers, S.; Tyler, S.; Campbell, C. Lawrence Berkeley Lab., CA (USA). Apr 1990. 59p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC03-76SF00098. Order Number DE90016635. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents data and analysis on historic trends in electricity consumption and economic output in manufacturing industry for a number of newly-industrialized and developing countries. Combining energy and economic data, we show trends in manufacturing electricity intensity, and analyze the causes of change in intensity to the extent possible. For several of the countries we also show trends in electricity intensity at the sub-sectoral level. Since 1975, there have been large increases in aggregate intensity in Thailand, Brazil, Argentina, Mexico, and Venezuela, large decreases in Taiwan and China, and little net change in South Korea and India. While interpretation of trends is hampered by lack of data, the evidence suggests that the effect of change in the composition of manufacturing output on aggregate electricity intensity was much less important than the effect of change in intensity at the sub-sectoral level. Though we were unable to analyze change in composition within sub-sectors, it is evident that is affected electricity intensity. Comparison of aggregate manufacturing electricity use per unit of value-added (converted to US dollars) show that intensity in the mid-1980s varied by more than a factor of two among six countries. China and India, both of whom have relatively old equipment in their industries, are at the top of the range, while South Korea and Taiwan, both of whom have relatively new equipment, are at the low end. With the exception of India, there is a clear correlation between electricity intensity and the average price of electricity to industry. Comparison of intensity among 2-digit sectors, which gives a better sense of the relative efficiency of countries, also shows a considerable range for most sectors. 28 figs., 21 tabs.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 46921

46946 (ETSU-R–51) **The Department of Energy's renewable energy R and D programmes: Progress report 1988/89.** UKAEA Harwell Lab. (UK). Energy Technology Div. Feb 1990. 102p. Order Number DE90519536. Source: NTIS (US Sales Only), PC A06/MF A01.

The progress report presented covers biofuels including landfill gas and municipal waste digestion, refuse derived fuel combustion, straw and wood fuels, and passive solar design. Wind, wave and tidal energy research and development programmes, geothermal hdr and small scale hydropower, and general studies such as resource assessment and cost data collection, are reviewed. A table of targets, achievements and priorities for 1989/90 is given. (author).

46947 (NEI-FI–98) **Renewable sources of energy and new energy conversion techniques; an evaluation of the long term potential and competitiveness in Finland.** Kaimari, A. (Ekono, Helsinki (Finland)); Leino, P.; Tarjanne, R.; Kling, P. Ekono, Helsinki (Finland). 1988. 155p. (In Finnish). Order Number DE90518704. Source: NTIS (US Sales Only), PC A08/MF A01.

The objective of this report is to create a basic account of the renewable sources of energy and of new energy conversion techniques and to evaluate their technical readiness, competitiveness and potential to be developed as a part of the Finnish energy system. The present situation, technological development phase and potential of the most significant renewable sources of energy conversion techniques have been illustrated on the basis of Finnish and foreign studies. The environmental aspects are also part of the report and they have been handled in connection with every alternative. An account has been given of the cost aspects for the renewable sources of energy and conversion techniques which are interesting for Finland. Based on this an evaluation of the production possibilities and a comparison with the competing energy production forms has been made on a general level. The range of time has been chosen to cover a relatively long period, far into the next century, so that solutions at present which are on the laboratory or pilot plant level could then be commercially used. The competitiveness of the renewable energy sources has been studied on present level and within a long term range. The marginal values are based on rapid/slow raise of fuel prices and on the rapid/slow decrease of the costs for renewable sources of energy. Among the renewable sources of energy the low-head hydropower, windturbines, waste incineration and solar heating are best suited for supplementary production of heat and power in Finnish circumstances in the future. MHD-technology, pressurized fluidized bed combustion, hydrogen technology and fuel cells seem now to be the most relevant alternatives of the new conversion technologies.

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

46948 (DOE/ET/10815–140) **The magnetohydrodynamics coal-fired flow facility: Technical progress report, October 1, 1989–December 31, 1989.** Tennessee Univ., Tullahoma, TN (USA). Space Inst. Jul 1990. 47p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC02-79ET10815. Order Number DE90016303. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this report for the October–December 1989 quarter, UTSI reports on a multitask research and development program directed toward developing the technology for the steam bottoming plant of a combined cycle MHD steam power plant. During this quarter, a 135 hour Proof-of-Concept (POC) test was completed and the results are summarized. Results of more detailed analyses from a 263 hour test conducted the prior quarter are also reported. The primary emphasis was in testing stainless steel tube materials for service in intermediate temperature air heaters and superheaters and in evaluation of particulate removal devices, baghouse and ESP, on the MHD combustion product exhaust. Results of detailed analyses of the test tubes removed after exposure for 500 hours of testing are included. Results of reconfiguration of the superheater test module to achieve the temperatures desired for simulating the retrofit superheater condition are given. Preliminary analysis of results of ESP performance from testing with excess amount of potassium carbonate in the flow are also included. In the environmental program, the results of test conducted to verify compliance with the State operating permit are reported. Data from the remote air quality monitoring stations during the POC test are summarized. Performance of advanced instrumentation devices provided by both UTSI and Mississippi State University is summarized. Materials tests directed toward finding a satisfactory ceramic tube for service in a high temperature air heater are described. 16 figs., 2 tabs.

46949 (DOE/PC/79669–T2) **MHD [magnetohydrodynamic] retrofit of a coal-fired generating plant: Technical discussion.** MHD Development Corp., Butte, MT (USA). 1989. 328p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79669. Order Number DE90008837. Source: NTIS, PC A15/MF A01 - OSTI; GPO Dep.

The design, construction, and operation of an integrated, coal-fired magnetohydrodynamic (MHD)/steam power electrical generation system is an extremely important step toward commercializing MHD technology. This report describes the design requirements, including site requirements (Montana); power output and plant efficiency; plant arrangement; a description of MHD operations; coal seed system; combustor and nozzle system; channel/diffuser assembly; heat recovery/seed recovery; superconducting magnet; power management; instrumentation/controls; plant systems; pollution control; and cost estimation. 87 figs., 42 tabs. (CBS)

46950 (STEV-NYEL–90-1) **Magnetohydrodynamics MHD. Technology examination: Final report Jan 1990.** Braun, J. (JSB Ingenjoersbyraa AB, Trosa (SE)). Statens Energiverk, Stockholm (Sweden). Jan 1990. 28p. (In Swedish). Project STEV-411-235. Order Number DE90518766. Source: NTIS (US Sales Only), PC A03/MF A01.

After a short introduction to MHD Power Generation a survey of the international efforts is given, based mainly on results presented at the 10th International Conference on MHD Electrical Power Generation, Tiruchirapalli, India, December 4-8. Work on MHDES (the formerly U-500) in the USSR has been postsponed until further notice due the high costs of the redesigned magnet. The USSR has announced a review of its national energy policy including a decrease of nuclear reactors in the european part of the country and a fading-out of reactors with an outdated safety standard. In the report the time aspect of future MHD-work is discussed as well as the impact of competing technology. The importance of international cooperation is stressed an the part the ILG (International Liason Group) should play is outlined. Finally some new applications are mentioned. (authors).

3004 Thermionic Converters

46951 · **Thermionic converter emitter support arrangement.** Allen, D.T. To Dept. of Energy, Washington, DC (USA). USA Patent 4,927,599/A/. 22 May 1990. Filed date 6 Jul 1988. USA Patent Application 7-376,071. Int. Cl. G21C 7/00. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a support provided for use in a therminonic converter to support an end of an emitter to keep it out of contact with a surrounding collector while allowing the emitter end to move axially as its temperature changes. The emitter end is supported by a spring structure that includes a pair of Belleville springs, and the spring structure is supported by a support structure fixed to the housing that includes the collector. The support structure is in the form of a sandwich with a small metal spring-engaging element at the front end, a larger metal main support at the rear end that is attached to the housing, and with a ceramic layer between them that is bonded by hot isostatic pressing to the metal element and metal main support. The spring structure can include a loose wafer captured between the Belleville springs.

3005 Fuel Cells

46952 (CRIE-W–89011) **Basic study of solid oxide fuel cells.** Mori, N.; Hisamatsu, T.; Yuri, I.; Abe, T.; Ishikawa, H. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Nov 1989. 27p. (In Japanese). Order Number DE90517069. Source: NTIS (US Sales Only), PC A03/MF A01.

Together with prototypical making of cell and test unit of solid oxide fuel cell (SOFC), basic study was made about the development of cell. High temperature test portion proper, heat resistant property and high temperature strength being taken into consideration, was made of Si_3N_4. The cell was fixed and sealed at the fore end of support part, made of ZrO_2, and inserted into the test portion proper. As a result of experiment, using hydrogen as fuel, the test unit was confirmed to be able to safely and simply test air and fuel at the SOFC operation range of temperature, 800 to 1100 centigrade. Cell, prototypically made by dipping is not good because electrolyte has open air holes having crossleak occur. Cell which is tape formed by doctor blade or press formed of partially stabilized zirconia, coprecipitated has small contact area between collecting electrode and electrode, and is so small in output power that further heightening is necessary in performance. 3 refs., 19 figs.

46953 (CRIE-W–89021) **Endurance test of 1kw class molten carbonate fuel cell.** Hayasaka, Y.; Watanabe, T.; Izaki, Y.; Mugikura, Y.; Abe, T.; Hamamatsu, T.; Ishikawa, H.; : Kahara, T.; Takahshi, T.; Takeuchi, M. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Dec 1989. 52p. (In Japanese). Order Number DE90517068. Source: NTIS (US Sales Only), PC A04/MF A01.

In order to study the durability of molten carbonate fuel cell, a 1kW class stack was prepared for experimental purpose, and continuous operation test for 1500-hour power generation under 60% fuel utilizing ratio, was carried out. The initial performance of the stack was 1.21kW in DC rated output power, 749mV in mean voltage, and voltage deviation in 12 composed cells of the stack remained comparatively in small value. The energy conversion efficiency of the stack increased with increasing fuel utilization ratio, and it was 44% at 80% fuel utilization. Some of the cells showed the target value in the decay rate, but the average rate of the stack was about five-time bigger than the target value. The cause of the cell performance lowering was due to the oxidation of fuel electrode by the leakage of cathode gas. The leakage was considered to be generated from wet-seal part and cross-over through electrolytic plate. The cause of the gas leakage was depend on the decrease in electrolyte in electrolyte plate due to the corrosion of separator plate. 4 refs., 44 figs., 8 tabs.

46954 (ECN-C–90-027) **Membrane-based thin layer SOFC-technology: Third progress report, January-June 1990.** Huijsmans, J.P.P. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1990. 22p. Contract CEC EN3E-0173-NL. Order Number DE90519652. Source: NTIS (US Sales Only), PC A03/MF A01.

The cooperative research program of ECN and the University of Twente (UT) on the title subject includes the following activities: Task 1 (ECN): development of a flat plate support/air-electrode composite; Task 2 (UT): application of a membrane on the supported air-electrode as a basis for thin electrolyte structures; Task 3 (UT): application of thin electrolyte structures by (E)CVD techniques; Task 4 (ECN and UT): characterization of microstructures and electrochemical properties of components and composites; Task 5 (ECN and UT): interaction between electrode material and thin electrolyte structures. Work in the period January-June 1990 is summarized. 6 figs., 8 refs.

46955 (EUR–12249) **Market potential of solid oxide fuel cells (SOFC): Final report, July 1987–September 1988.** Lilley, P.D. (GEC Research Ltd., Leicester (UK). Engineering Research Centre); Erdle, E.; Gross, F. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 211p. Sponsored by Commission of the European Communities. Contract EN3E-0163-UK. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 17.50.

This project is one of four sponsored and supported by the Commission of the European Communities (CEC) into Solid Oxide Fuel Cells (SOFC) during 1987/88. The main aim of the work reported here was to identify market areas that would be accessible to mature SOFC technology; and, where possible, to quantify these at and beyond the time that the technology becomes commercially available. Design concepts and configurations, and cost estimates are also provided. 55 refs., 52 figs., 38 tabs.

46956 (PB–90-244369/XAB) **Mechanisms of the electrochemistry of small organic molecules. Low temperature methane activation. Final report (for the period March 1, 1989-March 1, 1990).** Frese, K.W. SRI International, Menlo Park, CA (USA). 14 Jun 1990. 68p. Contract GRI-5083-260-0922. Source: NTIS, PC A04/MF A01.

Methane gas, dissolved in aqueous electrolyte, was found to react with dissolved oxygen at room temperature by an electrochemical mechanism. The O_2 was activated by electrochemical injection of electrons to form the radical anion. The methane, in turn, was activated by reaction with the radical anion in a concerted step including the electrode surface. The major products of the reaction were CH_2O and CH_3OH. Much smaller amounts of CO and CO_2 were also formed. The conversion of methane to CH_2O and CH_3OH was measured to be about 75%. CO and CO_2 comprised only 1% of the product. It is assumed that the reaction is aided by the known, very long lifetime of the radical anion in alkaline solution. The lifetime has been measured to be hundreds of seconds in 0.1 mM concentration. The protonated form of the radical, O_2H, has orders of magnitude shorter lifetime and may not be reactive toward CH_4.

46957 (PB–90-244385/XAB) **Electrochemical characteristics of acid electrolytes for fuel cells. Annual report, January 1, 1989-December 31, 1989.** Adzic, R.; Gervasio, D.; Kanamura, K.; Razaq, A.; Razaq, M. Case Western Reserve Univ., Cleveland, OH (USA). Case Center for Electrochemical Sciences. 31 Jan 1990. 67p. Contract GRI-5084-260-1108. Source: NTIS, PC A04/MF A01.

See also PB–89-178768.

Five topics investigated by the Gas Research Institute (GRI) contractors at Case Western Reserve University (CWRU) during the past year included: (1) electrochemical evaluation of perfluorinated electrolyte, (2) the Nafion solid polymer electrolyte (SPE) fuel cell, (3) electrochemistry of single crystal Pt electrodes in acid solution, (4) catalytic effects of adatoms entrapped on electrode surfaces by bipolar or monopolar ion exchange membrane layers, (5) investigations of the Fleischmann-Pons phenomenon. The principal objective of the project is to evaluate new acid electrolytes. Electrochemical evaluation was made for two bis-phosphonic acids as a replacement for phosphoric acid as a fuel cell electrolyte, and also a bis-sulfonyl carbon acid as an additive to concentrated phosphoric acid electrolyte for acid H_2-O_2 fuel cells. Electrochemical characteristics were found for these new perfluorinated acids.

46958 (PNL-SA–18162) **Advanced materials for high-temperature solid electrolyte applications.** Bates, J.L.; Chick, L.A.; Weber, W.J.; Youngblood, G.E. Pacific Northwest Lab., Richland, WA (USA). May 1990. 13p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC06-76RL01830. (CONF-900546–13: 4. conference on fossil energy materials, Oak Ridge, TN (USA), 15-17 May 1990). Order Number DE90016328. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Advanced materials for use as electrodes, interconnections, and electrolytes in high-temperature electrochemical applications are under investigation. The air sinterability of $La_{1-x}Sr_xCrO_3$ is highly dependent upon a synergistic relationship between the (La + Sr)/Cr ratio, cation volatility, and second phase formation and transformation. Electrical conductivity in the ZrO_2–Y_2O_3–CeO_2 and ZrO_2–Y_2O_3–TiO_2 systems is highly dependent on composition and atmosphere. The electrochemical processes that occur at the solid-solid-gas interfaces in La(Sr)MnO_3/$ZrO_2(Y_2O_3)$ have been studied using an unbonded interface cell and impedance spectroscopy. 6 refs., 7 figs.

46959 **Preventing CO poisoning in fuel cells.** Gottesfeld, S. To Dept. of Energy, Washington, DC (USA). USA Patent 4,910,099/A/. 20 Mar 1990. Filed date 5 Dec 1988. USA Patent Application 7-279,694. Int. Cl. H01M 8/04. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes proton exchange membrane (PEM) fuel cell performance with CO contamination of the H_2 fuel stream which is substantially improved by injecting O_2 into the fuel stream ahead of the fuel cell. It is found that a surface reaction occurs even at PEM operating temperatures below about 100° C. to oxidatively remove the CO and restore electrode surface area for the H_2 reaction to generate current. Using an O_2 injection, a suitable fuel stream for a PEM fuel cell can be formed from a methanol source using conventional reforming processes for producing H_2.

46960 **Manifold seal for fuel cell stack assembly.** Schmitten, P.F.; Wright, M.K. To Dept. of Energy, Washington, DC (USA). USA Patent 4,849,308/A/. 18 Jul 1989. Filed date 17 Mar 1988. USA Patent Application 7-169,531. Int. Cl. H01M 8/24. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes assembly for sealing a manifold to a stack of fuel cells. It includes a first resilient member for providing a first sealing barrier between the manifold and the stack. A second resilient member provides a second sealing barrier between the manifold and the stack. The first and second resilient members are retained in such a manner as to define an area therebetween adapted for retaining a sealing composition.

46961 **Overcharge tolerant high-temperature cells and batteries.** Redey, L.; Nelson, P.A. To Dept. of Energy, Washington, DC (USA). USA Patent 4,849,309/A/. 18 Jul 1989. Filed date 1 Aug 1988. USA Patent Application 7-227,021. Int. Cl. H01M 10/44. 12p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes how, in a lithium-alloy/metal sulfide high temperature electrochemical cell, cell damage caused by overcharging is avoided by providing excess lithium in a high-lithium solubility phase alloy in the negative electrode and a specified ratio maximum of the capacity of a matrix metal of the negative electrode in the working phase to the capacity of a transition metal of the positive electrode. In charging the cell, or such cells in series and/or parallel, chemical transfer of elemental lithium from the negative electrode through the electrolyte to the positive electrode provides sufficient lithium to support an increased selfcharge current to avoid anodic dissolution of the positive electrode components above a critical potential. The lithium is subsequently electochemically transferred back to the negative electrode in an electochemical/chemical cycle which maintains high self-discharge currents on the order of 3-15 mA/cm^2 in the cell to prevent overcharging.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

46962 (NEDO-P–8924) **Actual status survey on energy consumption in household use.** New Energy Development Organization, Tokyo (Japan). Mar 1990. 276p. (In Japanese). Order Number DE90517223. Source: NTIS (US Sales Only), PC A13/MF A01.

For the demand of household use energy, the objective of this survey is, together with systematic arrangement of data, using documents of research, so far made, to elucidate, through actual status survey by questionnaire, that energy in consumption structure and trend. Based on weighted average of specific energy consumption, region by region, for each of both commercial and household uses, national energy consumption unit was estimated. That unit was 275Mcal/m ^{2} *Y and 11406Mcal/household*Y for the commercial and household uses, respectively. By region, Hokkaido indicated an energy consumption figure, 1.9 times as large as that of nation. As a result of actual status survey by questionnaire, could be collected and arranged consumption structure and regional characteristics, business category by category, in the commercial use, and household attribution, regional characteristics, machinery maintenance, living pattern, etc. in the houshold use, and other information data, in a wide range, pertaining to the actual status of using energy. 230 figs., 43 tabs.

3201 Buildings

Refer also to citation(s) 46922, 46944, 47062, 47084, 47085, 47544

46963 (ANL/ESD/TM–10) **Minority Energy Assessment Model personal computer software documentation.** Anderson, J.L.; Miller, K.; Poyer, D.A.; Teotia, A.P.S. Argonne National Lab., IL (USA). Energy Systems Div. Jun 1990. 31p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-31109-ENG-38. Order Number DE90016664. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The personal-computer version of the Minority Energy Assessment Model (MEAM) provides a capability to assess the effects of changing prices (both energy and nonenergy) and income on energy demand and the patterns of energy use. The model is the result of a multiyear research project conducted for the Office of Minority Economic Impact (MI) of the US Department of Energy (DOE). The model provides the user with the options of either forecasting energy demand or comparing demand among different population groups. The documentation describes how to load the program on a personal computer and how to use the program. Examples of what the user should see on the computer screen are presented. This document also includes an appendix that provides a brief overview of the theory underlying the program. 20 refs., 12 figs., 6 tabs.

46964 (BR–170) **Energy use in buildings and carbon dioxide emissions.** Shorrock, L.D.; Henderson, G. Building Research Establishment, Watford (UK). 1990. 55p. Source: Available from Publication Sales, Building Research Establishment, Garston, Watford, WD2 7JR. Price Pound 25.00.

This report explores the relationship between energy use and the emission of the major greenhouse gas carbon dioxide. The emission, since 1950, of carbon dioxide due to the burning of fossil fuels is considered both globally and for the United Kingdom. This enables the more detailed analysis of the United Kingdom carbon dioxide emission considered here to be viewed with the global perspective in mind. Whilst the global emission of carbon dioxide has risen dramatically, the emission by the United Kingdom has remained fairly static. About half of the total United Kingdom emission can be attributed to the energy used by buildings and about 60% of this is attributable to dwellings. The potential for reducing carbon dioxide emission through the application of energy efficiency measures in dwellings is investigated, assuming that current patterns of primary energy use for heat and power generation do not change. It is possible to reduce the carbon dioxide emission currently associated with dwellings by 35% using proven technologies. Furthermore, the reduction due only to energy efficiency measures that are currently cost-effective is 25%. About two-thirds of these savings are due to improved insulation standards, with the remaining third being due to improved appliance efficiencies. (author).

46965 (CONF-900833–7) **Analysis of annual energy savings due to radiant barriers.** Wilkes, K.E. Oak Ridge National Lab., TN (USA). [1990]. 16p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990. Order Number DE90016524. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Radiant barriers are receiving increasing attention as an energy conservation measure for residential buildings, especially for warmer climates. They are being actively promoted for use in residential attics, sometimes with exaggerated claims about savings in utility bills that will results from their installation. In order to provide consumers with factual information that would assist them in deciding upon an investment in a radiant barrier, the Department of Energy, along with an industry advisory panel, has developed a Radiant Barrier Fact Sheet. A major part of this fact sheet is estimates of energy savings that might be expected from radiant barriers in various climates. This paper presents the details of the methodology underlying the energy savings estimates, and gives a summary of values listed in the Fact Sheet. The energy savings estimates were obtained from calculations using a detailed attic thermal model coupled with DOE-2.1C. A life cycle cost analysis was performed to estimate the present value savings on utility fuel costs. The results show that the fuel cost savings vary significantly with the level of conventional insulation already in the attic and from one climate to another.

46966 (KTM/E-D–181) **Ventilation and habitants' well-being and energy conservation.** Anttila, U. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. Feb 1990. 80p. (In Finnish). Project KTM-182/881/87. Order Number DE90518694. Source: NTIS (US Sales Only), PC A05/MF A01.

The purpose of the study has been to reach a social and behavioural point of view to residential ventilation questions. Theoretically, the subject is especially analyzed in the context of environmental and social psychology. Ventilation is seen as a factor which influences habitants well-being and energy consumption and the development of ventilation technique is considered in order to contribute to habitants' well-being and energy conservation. A minimum working principle of ventilation was developped for habitants' well-being. According to the minimum working principle of ventilation, ventilation technique should be developped in such a way that residential ventilation works well enough without habitants' action and the habitant would have an opportunity to regulate the ventilation. The minimum working principle of ventilation got support from the data which was collected from Turku and Vaasa. Habitants werecontent with their opportunities to regulate the ventilation of their apartment. In one ventilation system under investigation, both re-collection of warmth and habitants' opportunities to manipulate ventilation of their own apartment were arranged, and the system may be considered as a step towards habitants' well-being and energy conservation.

46967 (LBL–19735-Rev.1) **Overview of the DOE-2 building energy analysis program, Version 2.1D: Revision 1.** Birdsall, B.; Buhl, W.F.; Ellington, K.L.; Erdem, A.E.; Winkelmann, F.C. Lawrence Berkeley Lab., CA (USA). Feb 1990. 53p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016622. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The DOE-2 building energy analysis program was designed to assist engineers and architects in the performance of design studies of whole-building energy use under actual weather conditions. Program development was guided by several objectives: (1) that the description of the building entered by the user be readily understood by non-computer scientists; (2) that the calculations be based upon well-established algorithms; (3) that the program permit the simulation of commonly available heating, ventilating, and air-conditioning (HVAC) equipment; (4) that the costs of running the program be minimal; and (5) that the predicted energy use of a building be acceptably close to measured values. These objectives

have been met. We present here an overview of the DOE-21D version of the program. An annotated example of DOE-2 input and output is shown in the Appendix. 9 refs., 12 figs., 21 tabs.

46968 (LBL–28274) **Neutral format and automatic translations for building simulation submodels.** Sowell, E.F. (California State Univ., Fullerton, CA (USA). Dept. of Computer Science); Sahlin, P. Lawrence Berkeley Lab., CA (USA). Jun 1990. 22p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-890615–3: Building simulation '89, Vancouver (Canada), 23-24 Jun 1989). Order Number DE90016641. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Much current research is directed toward development of software environments that allow easy construction of building simulation models of widely varying structure and purpose. The example, TRNSYS has been in use for a number of years. Recently, several new such environments have been proposed. In spite of a considerable variation in model description formats among environments, the underlying mathematical models of physical processes are very similar. While one of the principal aims has been to allow easy sharing of models among users of the same environment, it has not been clear how portability was to be provided among different environments. Another objective has been ease of component model definition, in order to encourage modifications and additions to model libraries. This paper addresses both of these issues, by proposing a neutral and natural format for component model expression. The proposed format encourages equation based model definition because such models can be converted to efficient algorithmic form if needed, whereas the converse is not always true. Nonetheless, algorithmic component descriptions are also supported in order to allow reuse of existing models. Other key features of the proposed format are typing and declaration of linkage elements between models, which allow development of compatible component families, and enhance submodel exchange and reuse. The proposal considers underlying system modeling issues, including hierarchical submodel decomposition and methods for formal model expression that allow automatic translation to various simulation environments. Also discussed are the software tools needed for library maintenance and model translation. 12 refs., 1 fig.

46969 (LBL–28560) **Conjunction of Multizone Infiltration Specialists (COMIS) fundamentals.** Feustel, H.E.; Rayner-Hooson, A. (eds.). Lawrence Berkeley Lab., CA (USA). May 1990. 115p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016649. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The COMIS workshop (Conjunction of Multizone Infiltration Specialists) was a joint research effort to develop a multizone infiltration mode. This workshop (October 1988–September 1989) was hosted by the Energy Performance of Buildings Group at Lawrence Berkeley Laboratory's Applied Science Division. The task of the workshop was to develop a detailed multizone infiltration program taking crack flow, HVAC-systems, single-sided ventilation and transport mechanism through large openings into account. This work was accomplished not by investigating into numerical description of physical phenomena but by reviewing the literature for the best suitable algorithm. The numerical description of physical phenomena is clearly a task of IEA-Annex XX "Air Flow Patterns in Buildings," which will be finished in September 1991. Multigas tracer measurements and wind tunnel data will be used to check the model. The agenda integrated all participants' contributions into a single model containing a large library of modules. The user-friendly program is aimed at researchers and building professionals. From its announcement in December 1986, COMIS was well received by the research community. Due to the internationality of the group, several national and international research programmes were co-ordinated with the COMIS workshop. Colleagues for France, Italy, Japan, The Netherlands, People's Republic of China, Spain, Sweden, Switzerland, and the United States of America were working together on the development of the model. Even though this kind of co-operation is well known in other fields of research, e.g., high energy physics; for the field of building physics it is a new approach. This document contains an overview about infiltration modelling as well as the physics and the mathematics behind the COMIS model. 91 refs., 38 figs., 9 tabs.

46970 (NEFF–349/FN-2.331-0.86) **Applying stochastic methods to building thermal design and control: Synthesis report (1987 - 1989).** Scartezzini, J.L. (Solar Energy and Building Physics Laboratory, Ecole Polytechnique Federale de Lausanne (CH)); Bottazzi, F.; Nygard-Ferguson, M. Nationaler Energie-Forschungs-Fonds (NEFF), Basel (Switzerland). 1990. 30p. Order Number DE90513606. Source: NTIS (US Sales Only), PC A03/MF A01; NEFF Secretariat, P.O. Box 1564, CH-4001 Basel, Switzerland.

The object of this project is to develop numerical tools based on stochastic methods, issued from the theory of probability. Two objectives have been identified: I. The development of stochastic simulation techniques for thermal design and analysis of passive solar systems and buildings; II. The development of strategies for predictive controllers which can account for the stochastic behaviour of the weather and the occupants of buildings. The advantage of the stochastic approach is to treat the weather evolution and occupants behaviour by their probabilities. Previously to this work, an important effort was made towards the development of a stochastic approach to numerical simulations of passive solar systems. A smaller project has also treated the application of stochastic methods to predictive building thermal control. Encouraging results were obtained. They gave however rise to questions studied within the framework of this project: Design and analysis (hybrid dynamic simulation, Markovian stochastic simulation), predictive control. Two different institutions of the Swiss Federal Institute of Technology in Lausanne collaborate in this project: The 'Solar Energy and Building Physics Laboratory (LESO-PB)' in the Physics Department and the 'Chair of Operations Research' in the Mathematics Department. This document is a synthesis report of the work carried out within the project 'Application des methodes stochastiques: dimensionnement et regulation (Phase I)'. A detailed description of the results is available in French. (author) 20 figs., 10 refs.

46971 (NEI-FI–101) **Autonomous energy house; prestudy: Endreport.** Leppaenen, J.; Tervaportti, J. Neste Oy, Helsinki (Finland). 1989. 63p. (In Finnish). Project KTM-160/881/88. Order Number DE90518705. Source: NTIS (US Sales Only), PC A04/MF A01.

An autonomous energy house can be built in the climate of South Finland on the basis of strict energy savings and using passive and active solar energy. A total energy saving of 75% compared to a normal single family private house could be accomplished with reasonable procedures. The only sensible way of converting solar energy in nothern climates are flat plate thermal collectors and photovoltaic. Year around electricity demand can be met only by using hydrogen technology as a seasonal solar electricity storage. The excess electricity from solar cells in summer can be used to drive an electrolysis unit, in which water is dissolved to hydrogen and oxygen. The hydrogen can be stored in metal hydrates or to a high pressure gas cylinder. Electricity can be produced from the sored hydrogen by burning it in an internal combustion engine combined to a generator or in a fuel cell. Between the DC and AC nets of the house is a lead acid battery buffer, which delivers electricity to the load through AD/AC inverter. The waste heat from the components of the hdrogen system can be used to heat the house, when the rest of the heat demand can be satisfied by direct burning of hydrogen. The chosen energy production and conversion methods are new and partly laboratory stage technology, which economic production and potential is supposed to grow not earlier than in the beginning of the next century. The economics of these systems is greatly emphasized by the environmental questions and probable pollution taxes in the fossil energy production methods.

46972 (NEI-FI–120) **Guide for the design of a light fuel oil boiler plant.** Suomen Talokeskus Oy,. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 148p. (In Finnish). Project KTM-275/881/85. Order Number DE90518709. Source: NTIS (US Sales Only), PC A07/MF A01.

The study included the establishment of design standards for light fuel oil boiler plant on the basis of conventional design practices, dimensioning criteria and equipment selection as revised in the light of the latest knowledge in the field. The final report is based on detailed measurements at operational test plants, and on plant users' experience of the implementation of long-term maintenance management. The desing guide draws attention to some

basic solutions related to the use and maintenance of a boiler plant, that will help in the controlling of indoor air conditions so as to meet the residential target standards. The present guide is aimed at designers and technical training programmes. It is primarily applicable to new, low and high-rise residential blocks with individual boilers rated at less than 400 kW. The most important aspects of renovating existing blocks of flats, heated by light fuel oil, are also discussed in the guide. The study will serve as a basis for the drawing up of separate guides for building service personnel, concerning the use of light fuel oil boiler plants. The study deals with light fuel oil boiler plants as a whole, with special emphasis on the possibilities of attaining higher output rates by means of both plant design and proper operation and aiming at the increased comfort and satisfaction of the occupants at a reasonable cost.

46973 (ORNL/M–1007) **The OBCS [Office of Buildings and Community Systems] technology transfer program: A progress report.** Brown, M.A. Oak Ridge National Lab., TN (USA). Dec 1989. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90016499. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The mission of the US Department of Energy (DOE) Office of Buildings and Community Systems (OBCS) is to lead a national effort to achieve maximum, cost-effective energy productivity in the buildings sectors. To achieve this mission, OBCS is generating new technologies, research findings, methods, and databases in a wide range of building performance areas. The OBCS technology transfer program attempts to promote adoption and use of these research and development results. The OBCS technology transfer program seeks to enhance the adoption process by developing and implementing a system to transfer R&D results quickly, efficiently, and effectively to private- and public-sector users. The program supports technology transfer activities that will have a long-term, positive impact on the design, construction, and maintenance of energy-efficient buildings and community systems. Our focus is on promoting familiarity and confidence in OBCS products. This progress report provides an overview of the specific projects undertaken over the past year with support from the program. It concludes with a list of publications. 27 refs.

46974 (PB–90-247248/XAB) **Space-heating improvements in multi-family buildings. Final report, October 1984-October 1989.** Biederman, N.; Katrakis, J. Center for Neighborhood Technology, Chicago, IL (USA). Dec 1989. 305p. Contract GRI-5084-241-1036. Source: NTIS, PC A14/MF A02.

The final report presents the results of research on cost-effective energy efficiency improvements for existing low to moderate income multifamily buildings heated by gas-fired single pipe steam systems. Analyzed measures include indoor thermostats, main line vents, radiator vents, boiler derating, vent damper. Eleven buildings were instrumented and monitored over a three-year period to document the effect of the test measures on boiler gas usage, tenant gas and electricity usage, and indoor temperatures. The results indicate that proper specification and installation of thermostats, main line and radiator vent treatments and derating can result in 20% savings in annual space heating costs for a capital investment of under $200 per unit and a payback of under three years. They are applicable to almost all single-pipe steam heating buildings. They also can improve tenant comfort and reduce the tenant-borne expense of supplemental heating. Updated procedures are included for specifying and implementing the thermostat and vent treatments and for measuring their performance and boiler seasonal efficiency.

46975 (PB–90-247289/XAB) **Conventional research house zoned heating-test results. Topical report, January 1987-March 1988.** Leslie, N.P.; Carrington, J.S.; Ghassan, P.G.; Hedrick, R.L. Chamberlain Mfg. Corp., Niles, IL (USA). GARD Div. Sep 1988. 186p. Contract GRI-5086-245-1360. Source: NTIS, PC A09/MF A01.

See also PB–89-230619.

The comfort, energy consumption, and dynamic response of a forced-warm-air zoned heating system using a modulating gas-fired furnace was compared with the performance of a conventional central forced air distribution system for a one-story house located in Chicago. The house had a living area of 1,150 sq ft on the first floor and had a full basement. The house was uninhabited during testing. A computerized data acquisition system was used to obtain hourly and minute-by-minute data on weather, energy consumption, and comfort parameters. Testing on the central heating system was performed between January and May 1987. The zoned heating system was tested between January 1987 and March 1988. Seasonal energy consumption was determined by correlating daily energy consumption with average daily outdoor temperature and annualizing to a full heating season using historical weather bin data. Dynamic response was based on statistical analysis of minute-by-minute and hourly data during recovery from setback and during comfort hours after recovery from setback. Zoned heating provided superior comfort compared to central heat, especially in the basement. However, the cost of providing this comfort was high.

46976 (PNL–7224-Vol.1) **Cost data collection for manufactured homes in RCDP [Residential Construction Demonstration Project]: Volume 1.** Weakley, S.A.; Eckert, R.L.; Lee, A.D. Pacific Northwest Lab., Richland, WA (USA). Jan 1990. 27p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830 ;AI79-83BP13795. Order Number DE90016007. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the Pacific Northwest, a major effort has been made to improve the energy efficiency of new buildings. In the residential building sector, energy-efficient standards for new construction, called Model Conservation Standards (MCS), have been proposed; and demonstration projects are under way to implement MCS features and to explore new conservation possibilities. Bonneville Power Administration (Bonneville) administers a Pacific Northwest program to promote the construction and marketing of energy-efficient site-built homes. This program, Super Good Cents (SGC), pays incentives for new buildings that meet the MCS energy-efficiency levels. Starting in late 1987, Bonneville began a research and demonstration project to include HUD-code manufactured homes (homes built under the US Department of Housing and Urban Development's standards) in the SGC program. This report provides information on PNL's activities in collecting technical and cost data, and presents selected descriptive results from the cost database. Analysis will be performed under a separate Bonneville contract after energy, ventilation, and infiltration rate data are collected. 2 refs., 12 tabs.

46977 (TKK-KO/LVI–B22) **Mixing and displacement air distribution in office rooms.** Palonen, J.; Majanen, A.; Seppaenen, O. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1988. 126p. (In Finnish). Project KTM-291/881/85. Order Number DE90518692. Source: NTIS (US Sales Only), PC A07/MF A01.

The report deals mainly with the displacement ventilation and its applicability into the air conditioning of offices. In litterature survey the dimensioning of both mixing and displacement air distribution systems and the criteria of thermanl comfort in respect of temperature, temperature gradient and air movement are presented. The main emphasis of the research has been on the measurements in a model room. Two different mixing air flow patterns and three different displacement ventilation systems have been tested in the model. Cooling load, supply air flow and temperature have been variables in the measurements. The conclusion is that displacement ventilation can be used also in offices with certain limitations. Usually displacement ventilation requires greater supply air flow than mixing air flow pattern to remove the same amount of heat from the space. The temperature difference between room air and supply air is limited by temperature on the floor level and the vertical temperature gradient in the occupied zone. The cooling capacity of displacement ventilation may also be limited by the uncomfortable area close to the supply air registers.

46978 (TKK-KO/LVI–OT/89) **Indoor climate in flats and office buildings - HEPAC standard.** Seppaenen, O.; Kukonen, E. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1989. 16p. (In Finnish). Project KTM-291/881/85. Order Number DE90518693. Source: NTIS (US Sales Only), PC A03/MF A01.

The requirements and guidelines concerning the indoor climate in flats and office buildings are presented in the form of HEPAC-standard of the Building Information Institut in Finland. They

arplanned to serve as basis for HVAC-equipment design and building. Addressed are the indoor climate parameters that could be given the numerical values based on scientific research. Each indoor climate parameter description is provided with brief reference to other parameters concerned. Recommendations and treshold values are provided for thermal climate, airflow velocity, air humidity, air contaminants, outdoor air and supply air purity, odours, outdoor air flow rates and noise. Indoor climate is classified in two categories. The acceptable quality category refers to the requirements level published in the National Building Code of Finland, part D2. The other, good quality category, sets higher requirements for indoor climate. The treshold values are provided for both acceptable and good indoor climate.

46979 (VTT-ETRR–1) **Transparent thermal insulations - materials and uses.** Rautiainen, L. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Poltto- ja Voiteluainelab. Dec 1989. 51p. (In Finnish). Project KTM-300/881/87. Order Number DE90518699. Source: NTIS (US Sales Only), PC A04/MF A01.

ETRR Research Programme.

Transparent thermal insulation materials are products by which free solar energy can be used in several ways. Transparent insulations can be used in buildings as passive and active adaptations, for direct heating of buildings, heating of tap water or heating of seasonal energy storage. Insulation materials are transparent polymers or silicates. Manufacturing technics, properties and adaptations for use are developing fast. Some of products and adaptations have already been commercialized. Typical to transparent insulation technics is that each adaptation shall be planned separately according to climate, construction and economy in order to get an optimum solution. The short review of knowledge around transparent insulation and their use has been presented. The report is mainly based on information of 1st and 2nd international workshops concerning transparent thermal insulations.

46980 (VTT-TIED–1091) **HVACSIM⁺-program, user's experience.** Marjamaeki, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio); Heimonen, I.; Katajisto, K. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1990. 108p. (In Finnish). Order Number DE90518711. Source: NTIS (US Sales Only), PC A06/MF A01.

HVACSIM⁺ is a modular, non-proprietary computer simulation package developed at the National Institute of Standards and Technology (NIST) in Washington D.C. (previously the National Bureau of Standards, NBS), designed to allow detailed simulation of entire building systems: the heating, ventilating and air conditioning (VAC) system, the equipment control system, the building shell, the physical plant and the dynamic interactions among these subsystems. The HVACSIM⁺ package consists of a library of subroutines containing mathematical models of system components. The HVACSIM⁺ program has been in use since 1987 at the Laboratory of Heating and Ventilation of the Technical Research Centre of Finland. The objective of this project was to test and develop the program package according to the requirements of Finnish constructional engineering. In addition, new component models have been developed, such as the zone model for room air energy balance, models of actuators, heat exchangers for refrigerators, water radiators and thermostatic valves. The HVACSIM⁺ program needs four different error tolerances. The influence or error toterances on the accuracy of the solution is not explained in detail in the program manuals. Hence the effects of the error tolerances and time steps on the accuracy of the solution and on the simulation time were examined by example simulations. In addition, two different examples of system simulations using the HVACSIM⁺ program are presented. In the first example, the HVACSIM⁺ program was used to study the dynamic behaviour and the controllability of the heating coil control loop of an air conditioning system. In the second example, the program was used to study the heating and cooling demand of a building with varying inner and outer loads.

46981 (VTT-TIED–1112) **The Finnish construction techniques in the cold climate. Part 8. The construction site of technology.** Nykaenen, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Rakennetuotantolab.); Lahdenperae, P.; Nippala, E. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1990. 93p. (In Finnish). Order Number DE90518696. Source: NTIS (US Sales Only), PC A05/MF A01.

Construction wide Finland has 8 so-called cold months and 4 warm months. Thus most construction in this country takes place in wintry conditions. The study describes the most central methods and solutions in Finnish on-site construction. In winter the construction site requires heating, various methods of dehumidification and protection from weather. Especially foundation work and frame work are vulnerable to adverse weather conditions. The solution for year-round construction developed in Finland is the high standard prefabricated element system. The elements that are manufactured to a high level of completion in plants can be quickly installed on site even in winter. Allowances are made for winter-time construction in planning the production on construction sites. Work methods that enable construction work independent of the climatic conditions are chosen and planned at that time. Stages of work vulnerable to adverse weather conditions may also be scheduled for a more favorable season. The most advantageous time to launch a construction project is spring or summer. Then the frame construction phase is well under way or already completed as winter comes. A 10-11 day margin must be scheduled when the foundation or frame work is done in winter. When temperature drops to between -15 deg C and -25 deg C construction work must stop in accordance with the specific agreement enforced on each site. On-site techniques need to be developed further. Especially by improving protection against weeather and heating and dehumidification methods, it will be possible to make construction work more efficient and cut the costs due to weather. The development of construction methods applicable to cold-climate is also important. They usually entail transferring all work vulnerable to weather conditions into plants leaving the simple and quickly done installation work to be done on site.

46982 **Energy designs for architects.** Shaw, A. 349p. The Fairmont Press Inc., Lilburn, GA (USA) (1989).

This book examines the design considerations which need to be taken into account in meeting client requirements for building operating efficiency. Sitting elements including orientation and configuration, underground design options, and sun and wind control are explored. Topics discussed go from sitting and space planning through the construction process, covering building envelope, fenestration and other apertures, structure and mass, lighting, thermal systems, process and domestic hot water, and energy management and control systems. Detailed energy use and performance analysis techniques as well as payback assessment procedures are presented.

46983 **Working with the trades: integrating diagnostics.** Green, J. (Suburban Insulation, Hagerstown, MD (USA)); Neal, L.; Thomas, G. pp. 11 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Energy efficiency specifications are only as good as the contractor who installs them. This workshop reviews strategies which will incorporate diagnostic tools and techniques to encourage improved workmanship and effectiveness by the trades that ultimately affect the utility operating costs of a home. Primary consideration is given to air leakage, insulation and HVAC applications. As a result of this workshop, participants will: (1) Be aware of the experience of programs designed to encourage and train trades persons to use diagnostic equipment; (2) Understand contractor motivation and ways to encourage better workmanship; and (3) Learn about the effectiveness of incorporating diagnostic tools and techniques into the energy conservation process.

46984 **Assessing forced air distribution systems.** Downey, T. (Sun Power Consumer Association, Denver, CO (USA)); Tooley, J.,Jr. pp. 11 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop concentrates on problems associated with forced air distribution systems, including modifications that can have a dramatic effect on the operation and efficiency of the furnace. Methods and tools used to recognize major problems and strategies for cost effectively correcting them are described. This workshop is geared toward those individuals who are concerned

with both safety and increasing the efficiency of the heating system. As a result of this workshop, participants will: (1) Develop an understanding of how problems with the distribution system can impact furnace efficiency, comfort, energy cost and indoor air quality; (2) Gain knowledge of distribution system designs, possible problems, and ways to diagnose these problems; (3) Lean the most cost-effective ways of correcting air distribution system problems.

46985 **Measured results: Mobile homes.** Judkoff, R. (National Solar Energy Research Institute, Golden, CO (USA)); Laverty, J.; McBride, J. pp. 12 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop features researchers who have actually measured the energy savings from mobile home weatherization. The presenters have conducted controlled scientific studies measuring energy savings from various individual mobile home weatherization measures. This workshop is useful to program developers and others new to mobile home weatherization as well as researchers and practitioners conducting mobile home weatherization. As a result of this workshop, participants will: (1) Understand that substantial energy savings can often be obtained from mobile home weatherization; (2) Be aware of the range of energy savings that can be expected from various individuals weatherization measures; and (3) Understand how program design can influence energy savings.

46986 **Affordable housing through energy efficiency.** Prindle, W. (Alliance to Save Energy, Washington, DC (USA)); Groberg, R.P.; Hill, W.W. pp. 12 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop establishes the links between housing affordability and energy efficiency on a global scale, and describes a simple method for assessing these links in a specific project. It presents specific case studies of low- and moderate-income housing rehab where energy efficiency was used as a lead strategy for improving affordability. As a result of this workshop, participants will: (1) Get an overview of the links between energy efficiency and housing affordability, and see a practical tool for calculating this relationship for a specific project; (2) Lean about two Indiana projects that use energy efficiency as a linchpin for low-income affordable housing rehab efforts; and (3) Lean about a HUD/NAHB project that developed technical and financial methods for incorporating energy efficiency in low-/mod-rehab programs.

46987 **The art and science of critiquing program evaluations.** Garlow, N. (Columbia Gas of Pennsylvania, Greensburg (USA)); Collins, N.E. pp. 13 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The intent of this session is to enable conference attendees to make better use of information presented at subsequent sessions which report results of program impacts. They learn what to look for in program evaluation so that they can estimate potential transferability to their own programs, how to spot fatal flaws in design, and critical questions to ask of the presenters. As a result of this workshop, participants will: (1) Read selected program evaluation reports to be presented at the conference; (2) Reduce the reports to easy-to-understand findings and conclusions; (3) Learn to critique and compare these reports, with emphasis on identifying fatal flaws and transferring results to participants' own programs.

46988 **Understanding usage: Tracking energy consumption.** Aldridge, K. (North Carolina Alternative Energy Corporation, Research Triangle Park (USA)); Goldner, F.; Greely, K. pp. 13 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

By establishing standards and targets for fuel/electrical use in different building types, an energy usage analysis and tracking program is extremely useful in measuring the effectiveness of conservation measures and setting future mgt./govt. policy. This workshop explores both the value and the mechanics of developing an energy usage analysis and tracking program. Discussion deals with the following data issues: type, selection, collection, and analysis. The authors illustrate how to best apply and present the information derived from the study. Several PC and mainframe-based programs are reviewed.

46989 **Integrating blower doors into weatherization programs.** Blasnik, M. (GRASP, Philadelphia, PA (USA)); Nelson, G.; Dekieffer, R. pp. 17 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop addresses the many potential barriers and strategies to an integrated use of blower doors in low-income weatherization programs. The presentations and discussion are designed to motivate participants as they work towards creating the tailored solutions that match their specific applications of this diagnostic tool. As a result of this workshop, the participants will: (1) Become aware of the range of concerns associated with integrating blower door technology into weatherization work; (2) Discuss solutions to the barriers of integrating blower doors for different types of weatherization organizations; (3) Meet individuals with whom they can then have further discussions about their specific concerns.

46990 **Conserving energy in water heating.** Buggy, H. II (Current Energy Technologies, Indiana, PA (USA)); Schlegel, J.; Nadel, S. pp. 17 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop starts with a brief introduction on energy use patterns in domestic water heating. It then discusses different types of energy conserving retrofit measures from two points of view: (1) the practical installer and user perspective, and (2) the researcher perspective, i.e., how much energy savings do these measures actually produce. The workshop concludes with a discussion on replacement water heaters – how the different options compare. As a result of this workshop, participants will: (1) Discuss the practical aspects of measure selection and installation, so measures are satisfying to customers and last a long time; (2) Examine predicted and actual savings from conservation measures for existing domestic hot water systems; and (3) Lean about the different types of replacement water heaters on the market and how they compare from an economic point of view.

46991 **Low-cost mobile home measures for comfort and savings.** Desoto, R. (Colorado St. Div. of Housing, Denver (USA)); Thomas, S. pp. 18 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The workshop addresses low-cost measures which can often result in significant energy savings. The principal areas addressed include infiltration control, window treatments, simple heating system repairs and behavioral and lifestyle changes. Conditions that affect the cost effectiveness of these technologies are identified. As a result of this workshop, participants will: (1) Be able to identify cost-effective, low-cost mobile home weatherization measures; (2) Identify aspects of occupants behavior that impact mobile home energy savings; (3) Lean about state-of-the-art program designs and implementation strategies that integrate the behavioral and technical potential for cost-effective savings.

46992 **Rental weatherization: Who benefits?.** Ettinger, G. (Argonne National Laboratory, IL (USA)); Gerardi, R.; Hill, C. pp. 18 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop focuses on the treatment of tenants in publicly-funded low-income weatherization. In particular, it explores the degree to which tenants, as opposed to landlords, in fact experience the benefits of weatherization work and, where they do not, the steps which seem appropriate to assure their full participation in those benefits. The workshop also focuses on the leveraging of public funds through the acquisition of landlord contributions for the weatherization effort. As a result of this workshop, participants will: (1) Have a better understanding of the need to take steps to protect renters in weatherized structures; (2) Have concrete examples of how to protect renters' interests; (3) Appreciate the value of efforts to leaverage private funds with weatherization monies.

46993 Chimneys, venting, and backdrafting. Fugler, D. (Canada Mortgage and Housing Corporation, Ottawa, Ontario (Canada)); Geddes, D. pp. 21 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop covers the basic causes of chimney backdrafting and combustion spillage. It discusses the houses and systems at risk, and the potential remedies for the problem. A short video introduces the checklist procedure for verifying potential backdrafting. The presenters describe their field experience with these tests. As a result of this workshop, participants will: (1) Understand the levels of house depressurization that are hazardous to fuel burning; (2) Be able to identify the main causes of such depressurization and weak chimney drafts; (3) Become aware of the general testing procedure for determining the susceptibility of a house and venting system to such failure.

46994 Canadian model for total house tune-ups. Geddes, D. (Geddes Enterprises, Bramalea, Ontario (Canada)); Woods, T. pp. 22 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Affordable comfort has been the primary motivation for energy-related retrofit activities in Canadian homes for the last four years. This workshop shows a team approach to achieve this goal whereby envelope and mechanical contractors combine their talents for diagnostic and retrofit services. As a result of this workshop, participants will: (1) Have a better understanding of the need to adopt a systemized approach to house assessments; (2) Be able to put together a program to fit their own needs integrating building envelope and mechanical services to address residential thermal comfort, fuel savings, air quality, moisture and safety issues; (3) Realize that there is a world after weatherization full of wonderful opportunities.

46995 Comfort zones: Prospects & problems. Kelly, S.K. (Meridian Corporation, Alexandria, VA (USA)); Coyne, B.; McBride, J. pp. 22 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop focuses on issues relating to the implementation of comfort zones in low-income homes. It addresses the applicability of the technique and potential technical and behavioral barriers to implementation. The workshop emphasizes the sharing of the practical experience gained by people who have implemented comfort zones through the analysis of numerous case studies. As a result of this workshop, participants will: (1) Gain an understanding of the potential for zone heating; (2) From analyses of case studies, learn about possible energy savings from zone heating; (3) Obtain an understanding of the practical problems which may be barriers to implementing zone heating.

46996 Major mobile home retrofits. Kleyman, J. (Energy Research & Design Associates, Jackson, WY (USA)); Krigger, J. pp. 24 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Mobile homes and conventional stick-built housing are compared by contrasting the differences in construction techniques and building codes. The presenters discuss the development of major insulation retrofits of mobile home walls, floors and ceiling/roof assemblies. Techniques successfully used around the country are described and their installation costs, both in material and labor hours, are explained further. As a result of this workshop, participants will: (1) Gain a better understanding of how mobile home construction impacts energy use and the application of weatherization measures; (2) Learn three major retrofit techniques for walls, floors and roofs of mobile homes that add to insulation levels and reduce infiltration; (3) Hear the presenters' and participants' opinions on the installed costs, energy savings, problems and benefits of each retrofit technique.

46997 Determining cost effectiveness: A case study from Hood River. Khawaja, M.S. (Portland State Univ., OR (USA)); Peach, H.G. pp. 25 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop presents the cost effectiveness results of the Hood River Conservation Program. The main topic to be discussed is measure attractiveness and problems, i.e., which ones are too expensive to implement, which ones are cost effective, and which ones aid in enlisting participation (sexy measures), etc. As a result of this workshop, participants will: (1) Learn about the experience of running a large-scale weatherization program; (2) Learn about measures' costs and savings; (3) Learn about which measures to implement and which to avoid.

46998 Diagnosing air conditioners, heat pumps and refrigerators. Counts, D.M. (Alabama Power Company, Birmingham (USA)); Neal, L.; Tooley, J. Jr. pp. 28 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The session focuses on the critical factors in the design, installation and maintenance of air conditioners, heat pumps and refrigerators, which determine the energy efficiency of this equipment. Field research results, comfort, equipment life, distribution systems, programs to enhance quality installation and training need are among the topics discussed. As a result of this workshop, participants will: (1) Be able to identify major factors that contribute to field performance and efficiency of air conditioners, heat pumps and refrigerators; (2) Be able to describe symptoms of, and some methods to determine, inefficient operation; (3) Recognize the critical role of the installer and maintenance technician in achieving efficient operation.

46999 Air leakage control: Priorities, products, and techniques. Krigger, J. (Saturn Resource Management, Helena, MT (USA)); Nelson, G. pp. 28 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The presenters discuss how they decide what air sealing work to recommend for a house, considering cost effectiveness, moisture and indoor air quality. They also review the advantages and disadvantages of many of the materials they use for various types of leaks. Proper techniques for installing these materials in order to get durable cost-effective seals are demonstrated. As a result of this workshop, participants will: (1) Understand the role of the blower door in setting priorities for air sealing, considering cost effectiveness, moisture and indoor air quality; (2) Be able to identify effective and appropriate materials for a variety of leakage sites; (3) Be aware of the proper techniques for installing various materials in order to maximize durability and cost effectiveness.

47000 Approaches to auditing mobile homes. McBride, J. (National Center for Appropriate Technology, Butte, MT (USA)). pp. 29 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop addresses a number of issues related to conducting mobile home audits. Various mobile home audit methodologies are presented and special emphasis is placed on discussing how to determine savings existing levels in mobile home floors, walls and ceilings. The workshop should be useful to experienced mobile home auditors and novices alike. As a result of this workshop, participants will: (1) Be introduced to mobile home auditing; (2) Discuss technical aspects of mobile home auditing, e.g., determining current insulation levels in floors, walls and roof; (3) Share various audit methodologies.

47001 Row houses: Energy conservation considerations. Krengel, M.A. (Federal Department of Housing and Urban Development, Philadelphia, PA (USA)); Pustin, L.; Thomas, G. pp. 30 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop examines the unique characteristics of older brick row houses, including typical construction details and heat loss behavior. Particular attention is paid to air leakage problems and comfort issues. Specific concerns from historical restoration

requirements and budget constraints in redraft programs are addressed. Diagnostic approaches and prioritized treatment methods are offered. As a result of this workshop, participants will: (1) Become familiar with heat loss characteristics of row houses, with particular attention paid to air leakage; (2) Learn methods to predict and identify existing problems in repetitive housing stock; (3) Become more scientific in their understanding of row house behavior (driving forces, pressure differences, moisture).

47002 **Selecting and evaluating electric retrofits.** Greely, K. (Lawrence Berkeley Laboratory, CA (USA)); Hasterok, L.; Morita, E. pp. 31 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Past experience with electric retrofits and ways to achieve the most cost-effective savings are discussed in this workshop. Seattle City Light has attempted to maximize savings by screening multifamily weatherization program participants and targeting high users. The Wisconsin Energy Conservation Corporation has achieved cost-effective savings by focusing on lighting and other nonspace heating-end uses. Case studies with documented savings are used to illustrate their approaches. As a result of this workshop, participants will: (1) Learn how predicted savings compare with measured savings, and the measured potential for electric conservation savings in the U.S. multifamily stock; (2) Be exposed to a targeting strategy used to increase the cost-effectiveness of electric savings; (3) Recognize the energy conservation potential in multifamily dwellings for lighting retrofits.

47003 **Fresh air for a healthy environment.** Deklinski, J. (Pennsylvania Energy Office, Harrisburg (USA)); Benson, T.; Kleyman, J. pp. 33 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop reviews the need for controlled fresh air ventilation in resident environments and presents several heat and nonheat recovery ventilation options in detail. Design criteria are discussed as well as code requirements and recommendations. Actual installation problems and results are presented in light of Benson's extensive field testing for Bonneville Power Administration (BPA) and Battelle National Laboratory. This session is for those with a basic understanding of heat loss theory. As a result of this workshop, participants will: (1) Learn about several heat recovery and several nonheat recovery methods to provide controlled fresh air ventilation systems, pollutant source strength and occupant behavior; (2) Have a clearer understanding of the role of, and interaction among, mechanical ventilation systems, pollutant source strength and occupant behavior; (3) Learn basic principals of troubleshooting ventilation problems and designing ventilation systems for existing dwellings.

47004 **Beyond retrotec: integrated audits.** Kushler, M. (Michigan Public Service Commission, Lansing (USA)); Poole, C.; Schlegel, J. pp. 35 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop reviews different approaches to conducting energy audits in low income conservation programs. The workshop compares and contrasts three different energy audit systems, including priority lists and computerized audits. Methods of incorporating building shell and heating system measures into audits are reviewed, and diagnostic and technical approaches that increase program cost-effectiveness are emphasized. As a result of this workshop, participants will: (1) Have a broader understanding of audit options for weatherization programs; (2) Be able to select an energy audit method that best suits their program; (3) Being to identify ways to incorporate diagnostic and technical approaches to energy auditing, thereby improving the cost effectiveness of their program.

47005 **Radiant barriers.** Creech, D. (Southface Energy Institute, Atlanta, GA (USA)); Karnitz, M.; Yarbrough, D.W. pp. 35 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The use of attic radiant barriers in test houses has shown energy savings potential. Factors that effect the performance of radiant barriers and studies of their effectiveness are discussed. The status of current work to establish product standards, thermal performance, and cost effectiveness is presented. As a result of attending this workshop, participants will: (1) Understand the issues associated with the performance of radiant barrier systems; (2) Understand results that have been obtained from full-scale measurement of radiant barrier performance; (3) Understand results of field testing of radiant barrier systems and the resulting cost factors.

47006 **Moisture control and indoor air quality in mobile homes.** Benson, T.T. (Energy Inspection Technology, Lolo, MT (USA)); Kleyman, J. pp. 36 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session addresses the unique concerns regarding moisture and indoor air quality in mobile homes. The following topics are addressed: the significance of source strength, health and durability issues, occupant behavior, diagnosing problems and remedial measures. An understanding of the mobile home's combustion and ventilation system design provides some of the basis for identifying possible solutions. As a result of this workshop, participants will: (1) Know how to inspect for and identify potential indoor air quality problems, i.e., moisture, formaldehyde and carbon monoxide; (2) Understand the significance of existing and potential indoor air quality problems in the context of a mobile home environment; (3) Be involved in a discussion of possible solutions, both technical and behavioral.

47007 **Coupling energy and water conservation.** Lent, T. (Energy Coordinating Agency, Philadelphia, PA (USA)); Satterthwaite, K. pp. 36 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

In concert with the Energy Coordinating Agency of Philadelphia, the Philadelphia Water Dept. has designed a water conservation pilot program that helps low-income homeowners reduce their water bills through water conservation and waste reduction. Over 69% of the participants realized significant reductions in their water bills. This workshop describes how the conservation program was designed and implemented. As a result of this workshop, participants will: (1) Understand that a water conservation program can be cost effective to a utility; (2) View an example of utility/nonprofit program cooperation; (3) Begin thinking about how they could implement a program of this nature.

47008 **Volunteer weatherization efforts.** Clark, J. (Syracuse and Onondaga Energy Clearing House, NY (USA)); Dreyfuss, P. pp. 38 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Attendees interact with the presenters to brainstorm, plan, and develop methods of creating a volunteer weatherization implementation day using their own ideas, experience, and resources. Existing programs in Syracuse and Kansas City are presented. As a result of this workshop, participants will: (1) Gain knowledge of what makes up a volunteer program; (2) Be able to set up a volunteer program, either with in-house or community volunteers; (3) Match materials to implementing activities and individuals to tasks.

47009 **Health impacts of heat and cold.** Diamond, R. (Lawrence Berkeley Laboratory, CA (USA)); Talbert, R. pp. 39 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Certain populations, the elderly, the very young and the sick, may be at a greater risk to temperature extremes than the general population. This workshop identifies why the elderly are susceptible to hypothermia and hyperthermia and discusses ways to reduce this risk. Following the presentations, there is a discussion of case studies and the participants identify critical needs and issues for future study and action. As a result of this workshop, participants will: (1) Know why the elderly are particularly vulnerable to indoor temperature extremes; (2) Learn what measures can be taken to

reduce this risk; (3) Find out where they can obtain additional information about this issue.

47010 Improving combustion efficiency and safety. Davis, R.W. (Corporation for Ohio Appalachian Development, The Plains (USA)); Leatherman, R. pp. 41 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial addresses the combustion process and opportunities to improve its efficiency. Other topics include the equipment and training needs for heating system efficiency and safety inspections. Energy program managers and auditors as well as HVAC staff can benefit from this session. As a result of this tutorial, participants will: (1) Be familiarized with types and uses of combustion and safety equipment; (2) Have a greater understanding of the combustion process; (3) Be more aware of techniques used to increase combustion efficiency.

47011 Introduction to evaluation design. Collins, N.E. (Argonne National Laboratory, IL (USA)). pp. 41 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Program evaluations provide the program manager with the ammunition necessary to recommend programmatic changes and to demonstrate impacts of past program activities, such as energy savings or improved occupant comfort. This tutorial provides managers with both conceptual and practical information about how to use evaluation results and how to conduct their own evaluations. Emphasis is on evaluation designs, sampling, validity of results, interpreting results, and using these results to modify programs using case studies. As a result of this tutorial, participants will: (1) Acquire a basic understanding of types of program evaluation, their underlying philosophies and the benefits and uses of program evaluation results; (2) Learn to use primary evaluation tools – eight basic designs, sampling schemes, sample sizes, validity of results; (3) Apply new knowledge to examples of weatherization evaluation.

47012 Principles of air movement. Nelson, G. (The Energy Conservancy, Minneapolis, MN (USA)). pp. 42 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial examines some of the wheres and whys of air movement into, out of, and around the house. Topics addressed include: measuring pressure caused by exhaust and distribution fans; backdrafting and spillage; setting priorities for sealing leaks; ice dams as an indicator of air leakage; condensation in attics and walls; and interaction among house tightness, exhaust fans, furnace fans and chimneys. As a result of this tutorial, participants will: (1) Understand that houses are full of hidden paths through which air can flow, and recognize that finding and fixing these leaks is usually more important than conventional weatherstripping and interior caulking; (2) Understand the causes of pressure that drives infiltration and the importance of measuring this pressure; (3) Begin to understand interaction among the tightness of the house, the exhaust appliances, the forced air furnace, and the chimney.

47013 Blower door primer. Roussi, H. (Ohio Weatherization Training Center, Columbus (USA)). pp. 42 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session is for those who consider themselves blower door novices. It begins with a review of the pressure forces that cause air to move through structures. The parts of the blower door, its method of operation, and its uses are discussed. Finally basic interpretation of some mathematical estimates of leakiness is demonstrated. As a result of this tutorial, participants will: (1) Understand the forces that cause air to move through a structure; (2) Be able to describe the parts of a blower door, and how it can be used to detect and measure air leakage; (3) Have a rudimentary understanding of several measures of leakiness.

47014 Using the blower door (hands-on for novices). Coyne, B. (National Fuel, Erie, PA (USA)); Krigger, J. pp. 43 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The blower door is fast becoming an indispensable tool in effective conservation programs. The focus of this session is on preparing the house, setting up the blower door, taking measurements and interpreting test results. As a result of this tutorial, participants will: (1) Know how to prepare the house for a blower door test; (2) Be able to take measurements needed to conduct a test; (3) Be able to use a blower door to find leaks and interpret their relative priority.

47015 Integrating the blower door into weatherization programs. Blasnik, M. (GRASP, Philadelphia, PA (USA)); Schlegel, J. pp. 43 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

How to incorporate blower doors, infiltration guidelines, and associated health and safety procedures in a weatherization program is discussed in this tutorial. This session reviews different ways to implement blower door-guided procedures in a weatherization program and provides examples from several programs. Many commonly asked questions are answered during the session, including: (1) Who in my program should use the blower door and why? (2) How do I tell when a building is tight? (3) When should I stop sealing a building because it isn't cost effective? (4) How much should I reduce the leakage rate in a building? (5) Which leaks should I seal and why? (6) How much time and money should I spend in a building? (7) How can I use the blower doors to identify and help solve distribution system and backdrafting problems? As a result of this tutorial, participants will: (1) Have a clearer understanding of the issues related to incorporating blower doors into their programs; (2) Be able to see how blower doors can be used in their programs for a lot more than locating leaks; (3) Be able to calculate rule-of-thumb guidelines for their programs (cost effectiveness, minimum ventilation) and work toward developing building/site-specific guidelines for their programs.

47016 Wet-spray cellulose: New applications in the residential market. Lytle, B. (Enersaver Products, Oklahoma City, OK (USA)); Miller, R. pp. 44 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Residential applications for wet-spray cellulose are emerging in response to the need for products that can effectively insulate and simultaneously reduce air leakage. Applications for insulating and sealing basement walls, rim joists, crawl space ceilings, and knee walls are demonstrated and considerations for use are discussed. As a result of this tutorial, participants will: (1) Be familiar with residential applications for wet-spray cellulose; (2) Recognize the added benefit this technique offers of reducing infiltration; (3) Know importance of site preparation, equipment operation and application technique for an effective installation.

47017 Sidewall insulation. Jones, D.M. (Ohio Weatherization Training Center, Columbus (USA)); Fitzgerald, J. pp. 44 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session outlines the basics of safely and effectively installing exterior sidewall insulation, with an overview of key inspection and installation procedures. Topics include: discussions of equipment options; access and installation strategies for various framing and wall surfaces; how to reach inaccessible bypasses, reducing air infiltration as a bonus for doing high-quality work. The knowledge required to develop decision-making skills is stressed. As a result of this tutorial, participants will: (1) Identify the steps critical to successfully implementing a sidewall insulation operation; (2) Identify those aspects of residential structures that can impede or compromise the safe and effective installation of loosefill insulation into an exterior frame wall; (3) Identify the access and installation procedures appropriate to the standard framing and interior/exterior wall surfaces encountered in residential structures.

47018 An introduction to affordable comfort. Belshe, R. (Residential Energy Conservation Consulting Group, Fairchild, WI

(USA)); Wilson, T. pp. 45 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Designed for individuals with decision-making responsibilities in the residential energy field, this tutorial assumes little previous technical knowledge. A comprehensive overview of issues and strategies in achieving affordable thermal comfort challenges them not with a recitation of the caulk and weatherstrip variety, but rather with an understanding of the complex energy flows in buildings. A discussion of appropriate retrofit strategies emphasizes how and why modification can lead to reduced energy consumption and improved thermal comfort. As a result of this tutorial, participants will: (1) Be prepared to profit more fully from the conference sessions and be able to ask more intelligent questions; (2) Gain a better understanding of the challenges of the technical community, and be able to perceive potential shortcomings of their program goals and performance; (3) Be able to provide better direction to their technical field staff, and be more productive in dealing with clients' energy concerns.

47019 **Air leakage control in high-rise multifamily buildings.** Woods, T. (CANAM Air Leakage Control Systems Corporation, Mississauga, Ontario (Canada)). pp. 46 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

High-rise multifamily buildings have been largely ignored as representing tremendous cost effective, fuel-saving potential by applying appropriate air leakage control measures. This workshop postulates that they are not difficult to deal with and suggests ways and means backed by case studies which have been monitored. Testing equipment, innovative foams and weatherstripping are demonstrated. Building science and environmental issues also are addressed. As a result of this tutorial, participants will: (1) Become familiar with the simple, logical and very effective method of assessing, reporting and estimating the air leakage component of the heating and cooling bills of large buildings. This methodology has been evolving in Canada for the last 12 years and is now in widespread use; (2) Be introduced to the latest in window testing equipment, standards, etc.; (3) Learn to love stack effect, the difference between air barrier and a vapor barrier, and how lack of understanding these is steadily wrecking existing and new high-rise buildings.

47020 **Diagnosing the whole-house interactions of forced air distribution systems.** Tooley, J. Jr. (Natural Florida Retrofit, Inc., Orlando (USA)). pp. 46 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial investigates pressurization and depressurization of residential housing caused by forced air distribution systems: MAD-AIR (Mechanical Air Distribution and Interacting Relationships). Reasons which are discussed include air distribution system design, system failure, airtightness of the home and homeowner interaction with the system. Diagnostics showing major problems in comfort, conservation and indoor air quality using the blower door and infrared camera are discussed. Solutions to this hidden and elusive puzzler are revealed. As a result of this tutorial, participants will: (1) Define whole-house interactions with forced air distribution systems (FADS); (2) Identify problems (leaks, construction, human interactions) with FADS with use of blower door and infrared camera; (3) Solve problems (comfort, conservation, and indoor air quality) caused by interactions with FADS.

47021 **How to do a mobile home audit (hands-on).** Kleyman, J. (Energy Research & Design Associates, Jackson, WY (USA)). pp. 48 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

In this tutorial, participants conduct an energy audit of a demonstration mobile home, using techniques developed by the presenter. Specific instruction focuses on how to audit and evaluate the heating and air distribution system, and how to determine insulation levels in the major structural components. Participants evaluate the results of their site audit and prioritize weatherization measures for the sample home. As a result of this tutorial, participants will: (1) Learn how to conduct an energy audit on a mobile home; (2) Assist in evaluating several auditing techniques developed by the presenter.

47022 **Gas heating system retrofits for safety and efficiency I (classroom).** Davis, R.W. (Corporation for Ohio Appalachian Development, The Plains (USA)); Leatherman, R. pp. 49 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Although often overlooked, the heating system has a high potential for savings. Opportunities for efficiency improvement in both the combustion and the distribution system are discussed. A tune-up procedure that addresses both safety and conservation is described. As a result of this tutorial, participants will: (1) Be familiarized with types and uses of combustion and safety equipment; (2); Be able to complete a more thorough heating unit inspection and tune up; (3) Become aware of appropriate retrofit options.

47023 **Steam balancing for single-pipe steam I (classroom).** Heim, P. (Minneapolis Energy Office, MN (USA)); Katrakis, J. pp. 49 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This classroom session introduces the participant to the basic operation of a single-pipe steam system. Various system components are identified and the problem of uneven heating and the reasons for it is discussed. The installation of a retrofit package to improve building comfort and reduce heating costs is presented. As a result of this tutorial, participants will: (1) Have a good understanding of the operation principle of a low-pressure steam system; (2) Be introduced to the specific components of a single-pipe system, their functions, and troubleshooting problems; (3) Know how to develop bid specifications to improve the heating balance of a steam building.

47024 **Measuring energy savings from billing data.** Kushler, M. (Michigan Public Service Commission, Lansing (USA)). pp. 50 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial focuses on the basics of designing and conducting an energy savings evaluation. Emphasis is on practical information for program managers or staff who are not experts in research or statistics, but need to understand the basics of calculating energy savings. A simple yet accurate method of calculating savings is presented, which can be applied to a single building or a large sample of buildings and does not require a computer. As a result of this tutorial, participants will: (1) Understand the basic functions and purposes of an energy savings evaluation; (2) Learn a simple and practical method for calculating energy savings from billing data (no computer required); (3) Learn useful tips for designing and conducting an accurate energy savings evaluation.

47025 **Moisture and home energy conservation.** Benson, T.T. (Energy Inspection Technology, Lolo, MT (USA)). pp. 51 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session explores the sources of moisture in a home. The focus of the session is on developing the participants' problem solving skills in addressing moisture-related concerns. The interaction among conservation measures, occupant behavior and moisture levels are addressed. This session is equally appropriate for participants with technical and nontechnical backgrounds. As a result of this tutorial, participants will: (1) Be able to identify the internal and external sources of moisture in homes, and their relative importance; (2) Understand the principles that govern moisture migration in homes; (3) Be able to recommend appropriate moisture control strategies.

47026 **Assessing backdrafting and spillage (hands-on).** Fugler, D. (Canada Mortgage and Housing Corporation, Ottawa,

Ontario (Canada)). pp. 52 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial takes a group through the inspection of a gas-heated house to determine whether it is susceptible to backdrafting or combustion spillage. During the inspection, the group discusses the health and safety issues, alternative testing methods, and potential remedial measures for houses that experience venting failures. As a result of this tutorial, participants will: (1) Be able to inspect a house for the potential of pressure-induced combustion spillage (or backdrafting); (2) Be able to advise occupants on the reasons for spillage, and the potential hazards involved; (3) Have some suggestions for homeowners on remedial measures to prevent spillage.

47027 The building as a system. Argue, R. (Renewable Energy in Canada Ltd., Willowdale, Ontario (Canada)); Marshall, B.; Woods, T. pp. 53 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The notion of the building as a system has evolved from the many problems produced by haphazard approaches to energy-related retrofit options. This tutorial helps to put this situation in perspective and includes case studies and problem-solving exercises. As a result of this tutorial, participants will: (1) Understand the notion of the building as a complex, interactive system and be aware of related building science principles; (2) Be motivated to adopt a more total system approach to their operations; (3) Have the tools and methodology for understanding more comprehensive house assessments.

47028 Infiltration control in row houses. Pustin, L. (GRASP, Philadelphia, PA (USA)); Thomas, G. pp. 53 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Row house construction creates unique infiltration problems. This tutorial covers the common air leakage sites and convective loops, examines the driving forces of infiltration, and offers solutions to difficult leakage problems such as restricted attic access and party walls. Treatment techniques are explained. Use of the blower door and other instrumented equipment to diagnose and assess row house leakiness is explored. As a result of this tutorial, participants will: (1) Be better able to diagnose, assess, and treat major air leakage sites in row houses; (2) Know which air sealing treatments are effective and which are not; (3) Be familiarized with complex flow paths, interhouse leakage, and attic treatments in small roof spaces.

47029 Cooling at the cutting edge: Comfort, conservation, and indoor air quality. Tooley, J. Jr. (Natural Florida Retrofit, Inc., Orlando (USA)). pp. 54 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial investigates cooling problems from a new approach: MAD-AIR (Mechanical Air Distribution and Interacting Relationships). Pressure differences across exterior and interior walls, ceilings and floors caused by air conditioning systems are deliberated. A large housing study and research project is presented showing that air conditioner systems can cause elevated utility bills, poor indoor air quality and loss of comfort to the homeowner and increased peak demand loads to the utilities. Diagnostics and sample solutions are discussed. As a result of this tutorial, participants will: (1) Define cooling loss, both sensible and latent, with regard to forced air distribution systems (FADS); (2) Discuss loss in comfort, conservation and indoor air quality by FADS and interacting relationships with the home owner; (3) Solve relationship problems with cooling FADS (fabrication, repair and retrofit).

47030 Residential applications for infrared scanning. Snell, J. (John Snell & Associates, Montpelier, VT (USA)). pp. 54 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Thermography is a powerful monitoring, training and diagnostic tool that is being used by those working in the residential energy conservation field. The technology, while not inexpensive, has proven to be a wise investment with such returns as improved work quality, more effective training for installers and auditors, accurate assessment of the effectiveness of installation techniques, better understanding of air leakage problems and control, and reduction of outright fraud. In this tutorial, the participant learns how thermography can be used in his or her program, how to begin, and how to maximize the benefits from infrared thermography. As a result of this tutorial, participants will: (1) Learn how other programs are using this diagnostic tool to improve their results; (2) Gain a basic overview of what thermography is, what conditions are needed for inspection, and what equipment is available; (3) Leave knowing how it will fit into their work and know what steps are needed to bring it on-line or improve your current use of it.

47031 Installing mobile home roof caps. Durnin, W. (Carlisle SynTec Systems, PA (USA)); Miller, R. pp. 56 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session includes discussions regarding mobile home roofing retrofits and the benefits of single-ply rubber membranes. A retrofit demonstration provides the participants with the basic technical knowledge required for estimating and installing a mobile home roofing retrofit. As a result of this tutorial, participants will: (1) Understand the benefits of reroofing mobile homes with one sheet single-ply membranes; (2) Obtain a basic technical understanding of the installation methods; (3) Obtain the knowledge needed to properly estimate the roofing material required to complete the retrofit.

47032 Gas heating system retrofits II (in-field). Davis, R.W. (Corporation for Ohio Appalachian Development, The Plains (USA)); Leatherman, R. pp. 57 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session gives the participants the opportunity to perform diagnostic safety, efficiency and distribution system tests and to recommend or rule out potential retrofit options. A thorough tune-up procedure is demonstrated. As a result of this tutorial, participants will: (1) Have a more complete understanding of combustion/distribution practices and principles; (2) Be more able to correctly select retrofit options; (3) Gain hands-on experience in performing diagnostic and safety tests.

47033 Steam balancing for single-pike steam II (in-field). Heim, P. (Minneapolis Energy Office, MN (USA)); Katrakis, J. pp. 57 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The field session gives the participant a hands-on view of a single-pipe system. System components are identified, the building's heating pattern is defined with emphasis on hot or cold apartments. The on-site evaluation includes an informal bid specification for improving the operation of the heating system with emphasis on improved comfort and a reduction in the annual heating bill. As a result of this tutorial, participants will: (1) Be able to identify the components of the boiler and distribution system in a single-pipe steam building; (2) Learn on-site data collection procedures for the purpose of developing an audit report; (3) Prepare a bid specification for retrofitting the steam system with a standard control package.

47034 PRISM [PRInceton Scorekeeping Method]: Basics and applications. Fels, M. (Princeton Univ., NJ (USA)); Reynold, C. pp. 58 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial provides the fundamentals of the PRISM (the PRInceton Scorekeeping Method) methodology for those who know very little about the program. Some discussion of new applications of PRISM (e.g., the cooling-only model for electricity data; the use of PRISM estimates for improved energy bills and for Home Energy Rating Systems) are included. As a result of this tutorial, participants will: (1) Become familiar with the advantages of standardized scorekeeping, primarily using the PRISM method; (2) Be

provided with an update of new applications of the PRISM software; (3) Be brought together with people who have the same objective (to determine savings most accurately), in order to discuss–and learn from–the problems that are encountered in the real world of scorekeeping.

47035 Conducting a moisture audit (hands-on). Benson, T.T. (Energy Inspection Technology, Lolo, MT (USA)). pp. 59 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session includes a visit to a house with moisture problems. Participants conduct a moisture audit to determine the cause(s) and recommend strategies for alleviating the problem. The importance of occupant involvement throughout is demonstrated. As a result of this tutorial, participants will: (1) Be able to identify the warning signs of moisture problems; (2) Apply a methodology for troubleshooting moisture problems in a home; (3) Be able to generate a variety of appropriate solutions to any given problem in response to the resources available.

47036 Applying diagnostics: An integrated approach to insulation and infiltration I (hands-on). Fitzgerald, J. (Jim Fitzgerald Contracting, Minneapolis, MN (USA)); Nelson, G. pp. 61 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The presenters, a building scientist and an insulation contractor, have worked together over the past six years on dozens of houses with difficult energy and moisture-related problems. In this hands-on tutorial they demonstrate their diagnostic approaches to prioritization, including re-evaluation of priorities as work progresses. Techniques used to strategically locate and tightly pack cavity-fill insulation to maximize reductions in infiltration are also demonstrated. As a result of this tutorial, participants will: (1) Understand why cavity-fill insulation should be considered an integral part of infiltration control; (2) Understand that the order in which measures are applied can eliminate the need for others; (3) Learn how to prioritize building shell retrofits using the blower door and the infrared scanner.

47037 Canadian total house tune-up (hands-on). Geddes, D. (Geddes Enterprises, Bramalea, Ontario (Canada)); Woods, T. pp. 61 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Affordable Comfort has been the primary motivation for energy-related retrofit activities in Canadian homes for the last four years. This tutorial demonstrates a model developed both to market and achieve this goal. The total house tune-up combines the talents of the envelope and mechanical contractor for diagnostic and retrofit services. Their visit functions both as an audit as well as a literal tune-up, involving occupant education, addressing bypasses, sealing ductwork and checking for backdrafting and other health, safety and moisture problems. As a result of this tutorial, participants will: (1) Be aware of the potential of Total House Tune-Ups in a real house situation; (2) Realize the potential for energy savings, improved comfort and increased safety, as shown on site; (3) Learn about the energy savings that result from the mechanical component of a whole-house tune-up and provide a return on investment of one to two years.

47038 Interpreting utility consumption: Short course for educators. Belshe, R. (Residential Energy Conservation Consulting Group, Fairchild, WI (USA)); Wilson, T.; Kinney, L. pp. 62 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Actual energy usage can provide a wealth of consumer-specific information. This tutorial is designed to develop the participant's capacity to interpret consumption history in order to better address each consumer's particular situation. As a result participants are able to better differentiate between structural and behavioral factors which determine the level of energy usage in a house and to avoid missing opportunities for savings. As a result of this tutorial, participants will: (1) Be able to take the mystery out of utility costs for customers and clients; (2) Be able to calculate baseload and heatingload, and know what to do with them once you have them; (3) Begin to be able to use consumption history to identify priorities and potential for education and conservation.

47039 Impact of installation on performance of heat pump and air conditioners. Counts, D.W. (Alabama Power Company, Birmingham (USA)); Neal, L. pp. 62 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The session focuses on the critical factors of installation which determine the actual energy efficiency of central air conditioners and heat pumps, the relationship of electric utilities to quality installation, and programs to guarantee quality installation to consumers. As a result of this tutorial, participants will: (1) Understand better the energy-related interests of heating and air conditioning contractors; (2) Understand that quality installation and service determines the energy efficiency of central air conditioners; (3) Be aware of programs which help contractors do quality work and receive rewards for quality work.

47040 Mobile home heating systems (hands-on). Kleyman, J. (Energy Research & Design Associates, Jackson, WY (USA)). pp. 63 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

In this tutorial, participants correct deficiencies in a mobile home forced air distribution system and learn how to balance the system for comfort and efficiency at the registers. The presenter also discusses HUD and building codes regarding furnace installation, furnace efficiency testing and what is an approved mobile home furnace. Other techniques for evaluation and correcting the heating system, not applicable to the model but useful in other situations are discussed. As a result of this tutorial, participants will: (1) Learn about the components of the mobile home heating and distribution systems, code requirements and general installation problems; (2) Learn how to analyze the efficiency of the distribution system and make changes to reduce heat loss and improve air delivery and comfort.

47041 Assessing forced air distribution systems I (classroom). Downey, T. (Sun Power Consumer Association of Denver, CO (USA)); Tooley, J. Jr. pp. 63 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop is for the person who wants to know what works and what doesn't in repair and troubleshooting, infiltration rate control through fixing forced air distribution systems, common but hidden botch ups that cause comfort, conservation and indoor air quality problems. As a result of this tutorial, participants will: (1) Be familiar with low cost/no cost materials (what works and what doesn't); (2) Be able to locate hidden leaks (with blower door and infrared scanners); (3) Understand the difference between repairing the return and the supply.

47042 Efficiency improvements in hot water multi-zone buildings I. Hasterok, L. (Wisconsin Energy Conservation Corporation, Madison (USA)); Pigg, S. pp. 64 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial addresses opportunities for increased efficiency and comfort in hot water multi-zoned buildings. Intended for those desiring fundamental knowledge of how such systems work and what can be done to improve their performance, the session first familiarizes the participants with the components and principles of hot water boilers and distribution systems. The balance of the session is devoted to discussing the applicability and range of savings from various energy efficiency improvement strategies for this type of heating system. As a result of this tutorial, participants will: (1) Become acquainted with the components and operation principles of multi-zoned hot water heating systems; (2) Be aware of various efficiency improvement options for these systems; (3) Be able to select appropriate efficiency improvements for a given system and estimate their savings.

47043 Boiler system modifications I. Dekieffer, R. (Sun Power Consumer Association, Denver, CO (USA)). pp. 65 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial discusses all types of water-based heating systems. The focus of the classroom portion is to review the operation, controls, distribution and the interrelationships between the various system components. Attendees get a practical presentation on how steam and hot water systems operate and what common problems are encountered. As a result of this tutorial, participants will: (1) Understand the basic operation and components of boiler systems; (2) Develop a clear picture of how the various boiler systems work and where there are potential energy savings; (3) Have a practical knowledge of hot the systems can operate in the field.

47044 Short-term methods for measuring savings: Low-cost options. Kinney, L. (Synertech Systems Corp., Syracuse, NY (USA)). pp. 65 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Elapsed time meters have a number of advantages in measuring the consumption of furnaces, boilers, hot water heaters, and other appliances. Among the most important are simplicity, low cost, and accuracy. This tutorial provides a quick review of the theory and recent practice of the technique, shows attendees how to install timers on typical oil and gas furnaces, and demonstrates how analyses are accomplished by both hand-calculator methods as well as via recently-developed software suitable for microcomputers. Finally, results from using elapsed timer techniques to measure savings in several recent conservation program evaluations are shown and discussed. As a result of this tutorial, participants will: (1) Understand the theory and practice of using elapsed-time meters and event counters to measure energy consumption; (2) Be exposed to a range of simple-to-use techniques for analyzing data read from the above mentioned sensors; (3) See graphic displays of the results of several energy conservation efforts which were analyzed using these techniques.

47045 Entrepreneurial skills for nonprofits. Callaway, J. (Battelle Northwest Laboratory, Richland, WA (USA)); Gorgas, C.; O'Bryant, M. pp. 67 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial explores the potential for enlisting the private sector's participation in low-income weatherization. Developing and maintaining a mutually satisfying relationship requires nonprofits to respond to the private sector's needs, and to deliver services as promised while ensuring the quality of work. By leveraging other resources, the nonprofit can maximize the effectiveness of program services. The session closes with a discussion of ways to develop additional opportunities drawn from the Partners in Low-Income Residential Retrofit (PILIRR) Program. As a result of this tutorial, participants will: (1) Develop an understanding of the reasons why the private sector becomes involved in low-income energy issues; (2) Learn how to develop and maintain a win-win relationship and why it is important.

47046 Applying diagnostics: An integrated approach to insulation and infiltration II (case studies). Fitzgerald, J. (Jim Fitzgerald Contracting, Minneapolis, MN (USA)); Nelson, G. pp. 68 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The presenters, a building scientist and an insulation contractor, have worked together over the past six years on dozens of houses with difficult energy and moisture-related problems. In these case studies they explain their diagnostic approaches to prioritization, including reevaluation of priorities as work progresses. The use of a blower door and infrared scanner to strategically locate places where tightly packed cavity-fill insulation maximizes reduction in infiltration is illustrated. As a result of this tutorial, participants will: (1) Understand that hidden, inaccessible air paths are often more important than the obvious leaks and that interior caulking and weatherstripping are usually necessary; (2) Understand that doing the same thing to all houses doesn't work and that crews must learn to choose the best option as they expose the problem; (3) Understand that quality control using diagnostic tools must be built in as part of the process of completing a job.

47047 Evaluating products and materials. Krigger, J. (Saturn Resource Management, Helena, MT (USA)). pp. 68 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

With the wide array of products and materials available, making the best selection can seem overwhelming. Common selection errors and strategies for determining the appropriateness of products for specific applications are addressed. Literature from the conference exhibits is used to demonstrate how to evaluate sales and performance information. The capability of products and materials to meet building and safety codes is also presented. As a result of this tutorial, participants will: (1) Understand the meaning of terms and standards used to rate conservation products; (2) Given a specific application, be able to identify criteria to use in product selection; (3) Be aware of new products available to the retrofit conservation field, and their most appropriate applications.

47048 Insulating mobile home floors (hands-on). Thomas, S. (National Center for Appropriate Technology, Washington, DC (USA)). pp. 70 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Using an occupied mobile home provided under the auspices of the West Penn Power low-income usage reduction program, participants view the procedures involved in insulating the belly of a mobile home using blown cellulose. Done correctly, mobile home floor insulation can increase comfort, significantly decrease infiltration and reduce space conditioning costs. Techniques for efficiently and effectively preparing and blowing mobile home floors are demonstrated. Special consideration is given to durability by addressing measuring taken to prevent frozen pipes and wildlife damage. As a result of this tutorial, participants will: (1) Understand the basic techniques involved in insulating the belly of a mobile home using blown cellulose; (2) Be able to recognize the components of infiltration control involved with floor insulation; (3) Be able to describe several strategies for ensuring the persistence of energy savings resulting from floor insulation.

47049 Assessing forced air distribution systems II (in-field). Downey, T. (Sun Power Consumer Association, Denver, CO (USA)); Kleyman, J. pp. 70 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session concentrates on putting into practice the methods discussed in the morning session. The authors assess the distribution system/furnace control operation and make modifications to the system as needed to improve efficiency and comfort. Methods for finding and sealing leaks from the duct work are addressed, and participants practice techniques for balancing the distribution system. As a result of this tutorial, participants will: (1) Learn how to assess the forced air distribution system of a heating or cooling system in a hands-on fashion; (2) Learn how to use the tools/equipment needed for assessing or modifying forced air distribution systems; (3) Learn the tricks of the trade or the easiest, most cost-effective ways of modifying the distribution system/furnace components.

47050 Efficiency improvements in hot water multi-zone buildings II (in-field). Hasterok, L. (Wisconsin Energy Conservation Corporation, Madison (USA)); Pigg, S. pp. 71 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session allows participants to do on-site inspections of one or more multifamily buildings. The inspection for each site includes identification of the heating system components, an instrumented analysis of steady-state combustion efficiency, identification of potential problems, and a discussion of possible retrofit options for the heating system. As a result of this tutorial, participants will: (1) Become acquainted with the components and operation principles of multi-zoned hot water heating systems; (2) Gain knowledge of

various efficiency improvement options for such measures; (3) Be able to select appropriate efficiency improvement options for a given system and estimate the savings from the same.

47051 **Boiler system modifications II.** Dekieffer, R. (Sun Power Consumer Association, Denver, CO (USA)). pp. 72 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial briefly reviews water-based heating systems with a focus on operation, control, distribution and the interrelationships between the various system components. The majority of the session is in the field examining how steam and hot water systems operate, what common problems are encountered and how to fix them. As a result of this tutorial, participants will: (1) Get a close-up view of the basic operation and components of boiler systems and feel more comfortable around them; (2) Develop a clear picture of how the various boiler systems actually work, including both combustion and distribution sides of the boiler; (3) Actually see where energy can be saved and what tools are needed in working on boiler systems.

47052 **An introduction to statistics for energy professionals.** Reed, J.H. (Oak Ridge National Laboratory, TN (USA)). pp. 72 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial is designed as an introduction/refresher for energy program personnel who occasionally need to use or interpret statistics on the job. The tutorial includes a review of basic statistical concepts, a review of techniques often used by energy analysts such as weather normalization, and practice in interpreting statistics found in evaluation reports. The objectives of this tutorial are to: (1) Review selected basic statistical concepts that are relevant to the evaluation of energy programs; (2) Review techniques, such as weather normalization, that are of special interest to energy analysts; and, (3) Practice interpreting the statistics used in the actual evaluation of energy programs.

47053 **Moisture migration in buildings: Mold, mildew, and rot.** Lstiburek, J. (Building Engineering Corporation, Downsview, Ontario (Canada)). pp. 73 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Case studies demonstrating the fundamentals relating to moisture problems are utilized. As a result of this tutorial, participants will: Be able to diagnose and solve moisture problems related to mold, mildew and rot without endangering/compromising health, safety, durability and comfort.

47054 **Troubleshooting utility bills (hands-on).** Kinney, L. (Synertech Systems Corp., Syracuse, NY (USA)); Belshe, R.; Wilson, T. pp. 74 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

An on-site allows participants to learn procedures to identify the cause of high energy usage in a home. Occupant interviews aid in understanding the behavioral factors that influence usage. Participants assess shower heads and determine the actual operating cost of appliances. Combined with consumption history and the occupant interview, this information provides the foundation for a customized education plan and weatherization strategy. As a result of this tutorial, participants will: (1) Know how to interpret utility consumption history in order to understand patterns of energy usage; (2) Be able to perform simple on-site procedures to determine actual operating cost of appliances; (3) Be able to integrate consumption history with the results of on-site inspection and customer/client interviews to identify causes of high energy cost.

47055 **Allergy-free/nontoxic/energy-efficient rehabs.** Kobet, R.J. (Energy Design Associates, Butler, PA (USA)). pp. 74 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session examines the subject of allergy-free, nontoxic design through building renovations that are energy efficient. The topics include recognizing potential allergens and toxins in the host structures, minimizing environmental irritants in existing buildings, and designing and constructing additions that are energy efficient. Case studies are included. As a result of this tutorial, participants will: (1) Be aware of potential hazards presented by toxins and allergens exposed during renovation; (2) Understand what makes an allergy-free/nontoxic environment; (3) Be able to assess what materials, substances, or items they can substitute for conventional, potentially offensive selections.

47056 **Advanced heat pump.** Ashley, J.L.; Matthews, J.D. To Department of the Navy, Washington, DC. USA Patent Application 7-405,828. 11 Sep 1989. 12p. Source: NTISPC N03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

This patent application discloses a heat pump which includes a first packed bed of liquid desiccant for removing moisture from outside air in the heating mode of operation, and a pump for transferring the moisture laden desiccant to a second packed bed which humidifies condenser heated inside air by adding water vapor to the air. The first packed bed, by removing moisture from the outside air before it passes through the heat pump's evaporator coils, prevents frost from forming on the coils. In the cooling mode of operation the second packed bed of liquid desiccant removes water vapor from the air inside of the building. The moisture laden desiccant is then transferred to the first packed bed by a second pump where condenser heat transfers the moisture from the desiccant to outside air.

3202 Transportation

Refer also to citation(s) 47113

47057 (EUR--12159) **Water-injection dredging: Development of a new dredging method for use in maintenance dredging: Demonstration project.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Water-Injection Dredging BV (Netherlands). Dec 1988. 41p. (In English, Dutch). Sponsored by Commission of the European Communities. Contract EE/347/86-NL. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price ECU 5.

In years gone by, a great many harbors were constructed all along the European coastline. However, in many areas nature continually endeavors to undo these human efforts. As a result, harbor authorities have to spend large sums of money on maintenance dredging each year. Consequently, many of the other plans made by these authorities have to be either delayed or abandoned altogether. Water-injection dredging B.V. has developed an entirely new and revolutionary dredging method which greatly reduces the cost of maintenance dredging. The new dredging method is carried out by a purpose-built vessel named "JETSED." This report contains a comprehensive final analysis regarding the technical and economic aspects of the demonstration project in connection with development of the new dredging method. In conclusion, examination of the results of the demonstration project shows the new dredging method to be both a technical and economic success. 5 refs.

47058 (RIVM--678902-002) **Estimation of the health risk of city dwellers in case of air pollution exposure during wintertime and the impact of traffic reducing measures.** Rombout, P.J.A.; Eerens, H.C.; Marra, M. Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Feb 1990. 53p. (In Dutch). Source: Rijksinstituut voor Volksgezondheid en Milieuhygiene, P.O. Box 1, 3720 BA Bilthoven, Netherlands.

The potential levels of urban air pollution are estimated on the basis of modelled and measured urban background concentrations of a number of risk relevant components (SO_2 and aerosols). The contribution of the traffic to the background levels is amongst others estimated by means of the CAR-model (Calculation of Air pollution from Road traffic). Effects of air pollution exposure are

mainly determined by means of results from epidemiological investigations (experimental animal research and clinical research). Correlation of the modelled potential exposure with exposure response relations from epidemiological investigations is the basis for quantitative estimation of the health risk. The modelled contribution of the urban traffic emissions to the air quality makes it possible to estimate the impact of traffic reducing measures on the health risk. Only short term effects (some days) of exposure to winter smog are taken into consideration. 72 refs., 4 tabs.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 46389, 46478, 46629, 46731, 46792, 46793, 46967, 47057, 47467

47059 (DOE/HWP–102) **Hazardous Waste Remedial Actions Program: Annual progress report for the period ending September 30, 1989.** Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office. Aug 1990. 331p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC05-84OT21400. Order Number DE90016542. Source: NTIS, PC A14/MF A01 - OSTI; GPO Dep.

The objective of the Department of Energy Hazardous Waste Remedial Actions Program (HAZWRAP) is to develop and promote an integrated approach to Defense Programs (DP) installation compliance with the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act that conserves DP resources for its primary missions while providing a technically sound and socially acceptable response that satisfies involved regulatory agencies. The HAZWRAP Support Contractor Office (SCO) continued to provide technical support to HAZWRAP during FY 1989 through programs administered by the Hazardous Waste Remedial Actions Division and the Waste Research and Development Division of the Office of Defense Waste and Transportation Management. The three programs are: Hazardous Waste Compliance Technology Program, Hazardous Chemical Waste Research and Development Program, and Environmental Restoration Program. This report describes the activities of the SCO in support of the three programs, each of which is described in an integrated fashion. This report first presents the activities that the SCO carried out directly. These activities include Environmental Restoration Program support, strategic planning, DP-wide Treatment, Storage and Disposal system planning and implementation, information systems planning and implementation, technology demonstration and development planning and coordination, regulatory analysis, technical analysis, program administration, and technology exchange. Next, detailed stand-alone summaries of the research and development projects that were sponsored in FY 1989 are presented, followed by reports for the soil and groundwater remediation technology demonstration projects and waste operations.

47060 (EUR–12107) **Waste heat utilization for the evaporation of brine: Demonstration project: Final report.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; AKZO Salt and Basic Chemicals Nederland BV, Hengelo (Netherlands). 1989. 17p. Sponsored by Commission of the European Communities. Contract EE/082/82-NL. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

This report describes the project comprising the design, construction and operation of a special type of evaporator situated between the last effect and the barometric condenser of a multiple-effect evaporation plant for the production of salt (sodium chloride). In this special evaporator about 40% of the heat that is normally – at a lower temperature level – transferred to the cooling water in the barometric condenser, can be used to concentrate the feed brine of the salt plant. This will save a substantial part of the energy needed for the evaporation of brine. The aim of the demonstration was: to operate for a longer period, on an industrial scale, the special evaporator mentioned, coupled to an existing brine evaporation plant. The calculated steam savings should be realized at reduced pressure. Moreover, the operating time of the plant should not be shortened due to any necessity to take the special evaporator out of operation in order to remove scaling; and to show that this apparatus can also be applied as a crystallizing evaporator, thus rendering it possible to construct less energy-consuming evaporators in a general sense. 8 figs., 3 tabs.

47061 (EUR–12108) **Concentration of technical gelatine by use of a three-stage falling film evaporator with mechanical vapour recompression (MVR): Demonstration project: Final report.** Trommelen, A.M.B. (Lijmfabriek Trobas BV, Dongen (Netherlands)); Schellekens, A.J.M. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Lijmfabriek Trobas BV, Dongen (Netherlands). 1989. 25p. Sponsored by Commission of the European Communities. Contract EE 349/85-NL. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

This report deals with the application of the technology of Mechanical Vapour Recompression in the evaporation-process within the (technical) gelatine industry. In the production process of technical gelatin a clarified solution of 5% protein in water, with a temperature of approximately 85°C, must be concentrated to about 35–40% dry matter. For that purpose multiple-stage falling film evaporators are frequently applied, in which the water is eliminated from the solution under reduced pressure. Despite serious start-up problems, it appears that concentration by means of an evaporator equipped with mechanical vapour recompression in this particular branch of industry is technically applicable as well, can be economically viable and proves to be a reliable technology. An energy saving of more than 90% in comparison with a conventional 3-stage evaporator with thermal vapour recompression has been achieved. Within the international field of technical gelatine-industry, the user company Lijmfabriek Trobas B.V. in Dongen–Holland is one of the major producers. 6 figs., 11 tabs.

47062 (EUR–12288) **Development of an advanced heat transformer and investigation of the combination heat transformer–absorption heat pump: Final report, April 1, 1986–December 31, 1988.** Bokelmann, H. (GEA Luftkuehlergesellschaft Happel GmbH und Co., Bochum (Germany, F.R.). Research and Development Dept.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; GEA Luftkuehlergesellschaft Happel GmbH und Co., Bochum (Germany, F.R.). Research and Development Dept. 1989. 95p. Sponsored by Commission of the European Communities. Contract EN 3E-0025-D(B). Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The objective of the report is to describe the proposed project for the development of an advanced heat transformer using new working fluids enabling the realization of higher feedback temperatures (>150C). The combination of heat transformer/high-temperature absorption heat pump is also under investigation. It is expected that a better overall COP can be reached by a such apparatus combination. 4 refs., 18 figs., 7 tabs.

47063 (EUR–12301) **Concentration of fish stickwater by mechanical vapour recompression: Demonstration project: Final report.** O'Neill, G. (Irish Agricultural Wholesale Society Ltd., Killybegs (Ireland)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 23p. Sponsored by Commission of the European Communities. Contract EE/528/85-IR. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

The project relates to the installation of a Mechanical Vapour Recompression (MVR) System of evaporation to concentrate Fish-stickwater at the Irish Agricultural Wholesale Society (IAWS) Fishmeal Plant at Killybegs, Co. Donegal, Ireland. This plant is the largest producer of Fishmeal for the Irish Market. Before the installation of the new MVR System, it handled 300 tonnes of raw material every 24 hours, with annual production of 7,000 tonnes of meal. The meal is bought by several Irish Co-operatives who are in

the Animal Food business and also many Irish private Millers. It is sold on a Protein basis, which ranges normally from 68% to 70% Protein range. The Plant also produces 3,000–4,000 tonnes of Fishoil every year, mainly for export to the UK. The main aim of the Demonstration Project was to install a Mechanical Vapour Recompression MVR System for the concentration of Fish Stickwater, thereby bringing about a much more economic, energy saving, and processing operation by recovery of solids from Stickwater; a large proportion of which has formerly dumped. This novel technological application has made maximum use of this by-product of fishmeal and fishoil manufacture and has achieved considerable improvements in the local environment. The MVR technology using turbo fans is a new application with fish waste in the EEC. The use of the turbo fans demands less electrical power and is easier to maintain. This application will benefit the competitiveness of the fish processing industry of the Community. 4 refs., 5 figs., 4 tabs.

47064 (NEI-FI–96) **Utilization of gas diesel in refiner mechanical pulp and groundwood preparation.** Jokivaara, A. (Teollisuussuunnittelu Oy, Kouvola (Finland)); Niemi, A. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1987. 85p. (In Finnish). Order Number DE90518707. Source: NTIS (US Sales Only), PC A05/MF A01.

Mechanical pulp production increases all the time in Finland which causes growth in electric power demand. The growth can be reduced by using gas-diesel engines as power source for grinding and refining. In the study, it was discovered that the use of diesel engines does not reduce the mechanical pulp production nor make its quality weaker compared with the use of electric motors. In fact, in the case of grinding, both the production may increase slightly and quality be better when using motors with adjustable shaft-speed. In favourable case, the use of gas- diesels reduced the total production costs of mechanical pulp as much as 137 FIM/t even at the current energy prices. In the example case the production costs reduced by 44-55 FIM/t. The payback period varied from 3 years in favourable case to 5 years in example case. In favourable case, the use of gas-diesels reduced the total production costs of groundwood pulp by 24 FIM/t at the current energy prices. In example case, the production costs increased by 11-17 FIM/t. The payback period varied from 6 years in favourable case to 11 years in example case. Utilization of diesels reduces the electric power demand 12 MW per TMP- and 10 MW per PGW-line. The total potential is 120-180 MW by the year 2000 in Finland.

47065 (NEI-FI–121) **Exvel turbo fan in paper machine steam and condensate systems and in vacuum systems.** Leskinen, S. (Ilmateollisuus Oy, Espoo (Finland)); Suominen, K.; Backman, J.; Pukkila, O.; Saeily, K.; Taehti, E.; Tiitinen, E.; Kurppa, H. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 61p. (In Finnish). Project KTM-29/881/86. Order Number DE90518710. Source: NTIS (US Sales Only), PC A04/MF A01.

Development of the Exvel Turbo Fan, which utilizes traditional fan technology, began in 1977. Tests conducted this year (1989) demonstrate that a single stage will produce up to 70 kPa overpressure and up to 100 kPa with an additional stage. The fan is suitable for such applications as industrial drying processes, fluidized-bed reactors and chemical engineering processes. In the case of paper machines, the Exvel Turbo Fan can be applied in the steam and condensate systems of the dry-end section as well as vacuum systems. For the steam and condensate systems, the fan is used for increasing steam pressure and in recovery of steam from mechanical pulping processes. In machine line applications flash steam from the drying section can be recirculated using Exvel fans. The advantages include lower energy consumption and a general lowering of the required steam pressure in the machine line. Further, the drying section is easier to regulate and can be circulated cascade-free. In this study, an Exvel Turbo Fan was installed in the machine line of a newsprint paper machine. The steam compressor was replaced by the Exvel Turbo Fan, thus allowing recompression of TMP steam in the drying section. The theoretical total power consumption of installed vacuum systems at paper mills in Finland is about 200 MW. According to studies by Finland's Ministry of Trade and Industry, an estimate of the potential savings through improved efficiency and optimization of fan operation would be about 50-60 MW. Applications utilizing properly installed Exvel Fans can provide energy savings in vacuum systems of 10 to 15 percent per mill. A plant-scale test of an Exvel Fan has been applied to the vacuum system of a cardboard paper machine in the autumn of 1989. The start-up of the rebuilt machine is scheduled for the end of 1989 and the test result should be available at the end of 1990. The designed underpressure value for the fan is 28 kPa.

47066 (NEI-FI–1005) **Decreasing TMP energy by developing refiner plates.** Huusari, E. (Sunds Defibrator Jylhae Oy, Kankaanpaeae (Finland)); Sopanen, T.; Ahlqvist, P.; Vihmari, P.; Nevaranta, J.; Kankaanpaeae, V. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 31p. (In Finnish). Project KTM-129/881/86. Order Number DE90518706. Source: NTIS (US Sales Only), PC A03/MF A01.

An essential factor of fiberizing process is the refiner plates between which the fibers of the wood can be separated by using high energy intensity. In this study alternative plate patterns, coatings and materials have been searched in order to be able to increase the efficiency of fiber treatment and accordingly save energy used in mechanical pulping. The first object of this development project with the best production result has been so called selective plate pattern. The basic idea of selective refining has been to make possible the escape of refined pulp and steam from the plate cap at the earliest possible stage. The energy savings reached by selective plates have been between 2 and 10% per refining line depending on the refining grade. The pulp quality with selective plates have not been essential different from pulp quality of standard plates. Selective plates are in use at present form in most TMP factories in Finland and patent applications have been made in most important target countries. The second object of this study has been developing so called grinding plates. The principle of grinding plates is based on a thought in which the refiners have no bars and grooves like normal plate patterns. Instead the fiberizing happens between two macro rough plates. The development work's biggest problem has been to find the right kind of manufacturing method for such surface. So far a few grinding plate pattern experiences have been made. Within these trials energy saving of 20% in maximum has been reached. In this case the pulp quality has not differed essentially from the present TMP. The third new plate construction within the study is ceramic plate material, which has also been one alternative to the grinding plate. The first ceramic plate assembly will be in trial at the beginning of 1989. After that it is possible to do further plans with this plate type.

47067 (PB–90-246752/XAB) **Compendium of national urban mass-transportation statistics for the 1986 report year. Annual report, 1 January-31 December 1986.** Pachler, F.T.; Porcelli, R.; Jordan, R.L.; Lederer, B.A. Materials, Communication and Computers, Inc., Alexandria, VA (USA). Apr 1990. 177p. Contract DTUM60-89-C-41008. Source: NTIS, PC A09/MF A01.

See also report for 1985, PB–89-109144.

The report provides summary statistics on the finances and operations of the United States' public transit systems for the 1986 calendar year. In the report, national transit industry financial operational characteristics are illustrated through use of (1) graphics designed to emphasize key transit industry patterns, (2) policy relevant statistics and aggregations, and (3) trend information incorporating statistics from the Section 15 database 1982, 1983, 1984, 1985, and 1986.

47068 (PB–90-247586/XAB) **Results of gas-fired flash-smelting tests. Phase 1-3. Topical technical report, November 1987-April 1989.** Pusateri, J.F. Horsehead Resource Development Co., Inc., Monaca, PA (USA). Jun 1990. 156p. Contract GRI-5087-235-1601. Source: NTIS, PC A08/MF A01.

A natural gas-fired burner for the HRD FLAME REACTOR Process was designed and successfully tested on over 450 tons of Electric Arc Furnace (EAF) dust, and over a wide range of operating conditions. The coal/coke-fired FLAME REACTOR Process has already been demonstrated as an efficient and economic means of recovering zinc from EAF dust as a salable oxide product, and a salable nonhazardous, iron-rich slag product. The results of the work indicate that the natural gas-fired process has a higher zinc

capacity for a given reactor size, with zinc recoveries 5-10 percentage points higher than coal/coke processing at high throughputs. Gas-fired capital costs are about 15% less than coal for a 20,000 STPY EAF dust plant. Smaller plants show even higher break-even costs. Net processing costs are about $100/ton of EAF dust, which is extremely competitive with land-filling and other recycling options.

47069 (SAND–90-0935C) **Sandia National Laboratories' work in solar detoxification of hazardous wastes.** Alpert, D.J. (Sandia National Labs., Albuquerque, NM (USA)); Sprung, J.L.; Pacheco, J.E.; Prairie, M.R.; Reilly, H.E.; Milne, T.A.; Nimlos, M.R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-9008139–1: 5. international symposium on solar high-temperature technologies, Davos (Switzerland), 27-31 Aug 1990). Order Number DE90016106. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories is working with the Solar Energy Research Institute to develop and apply solar technology to the destruction of hazardous chemicals. The program is part of the United States Department of Energy's Solar Detoxification of Hazardous Waste Initiative. Sandia's efforts are focused on two distinct technologies for destroying chemical wastes: a low-temperature, photocatalytic process for destroying dilute organic compounds in water and a high-temperature thermal/chemical process that destroys organic wastes by steam reforming over a metal catalyst. In support of both areas, laboratory studies are performed to screen alternative concepts, to identify reaction products, and to quantify key processing parameters. Sandia's experiments are conducted in the field with sunlight at a scale approaching that needed for industrial applications. The objective of Sandia's efforts is to spur commercial application of these technologies by demonstrating their feasibility at this practical scale. 31 refs., 10 figs.

47070 (SAND–90-7032) **The design, testing and fabrication of an extruded, linear focus Fresnel lens.** Kaminar, N. (Solar Engineering Applications Corp., San Jose, CA (USA)); Curchod, D. Sandia National Labs., Albuquerque, NM (USA); Solar Engineering Applications Corp., San Jose, CA (USA). Aug 1990. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90014852. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this program is to design and fabricate an extruded, curved, linear-focus Fresnel lens for use in a photovoltaic module operating at 10X concentration. The extrusion process is the least expensive lens manufacturing process, producing a lens at approximately 10$/m^2. A goal to achieve 70% optical transmission was set. When used in a module, the housing sides are planned to be co-molded with the lens. This provides the least expensive module design available today. A 7-inch wide lens has been designed, and tooling has been fabricated. Several trial extrusions have been made, with the best to date giving a 73% transmission. A post forming tool was designed and fabricated that improves the molded tooth profile to within 0.001 inch of the design. The achievement of over 70% transmission has shown that a photovoltaic system with an installed AC buss-bar electricity cost of under $0.06/kWh can be produced. Solar Engineering Applications Corporation (SEA) is working on a second-generation extruded lens with the goal to achieve 80% transmission and incorporation into a module. 2 refs., 15 figs.

47071 (VTT-TIED–1098) **Review of knowledge based technology for steel and base metal industries, experiencies and tools.** Koponen, P. (Valtion teknillinen tutkimuskeskus, Espoo (Finland). Saehkoe- ja automaatiotekniikan Laboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1990. 78p. (In Finnish). Order Number DE90518697. Source: NTIS (US Sales Only), PC A05/MF A01.

Knowledge based applications and tools were reviewed in spring 1989 based on the experiences and the characteristic requirements of the steel and metal production in Finland. In this field some expert system development tools have already been applied and more applications are coming out in the near future. The success of the systems has varied from daily production use to replacing and expert system shell with conventional programming. Some problems in building expert systems became apparent during this review. The domain specialists and knowledge engineers have had to contribute a lot of their time. There is no real general purpose tool. Those that are flexible and support representation of complex knowledge are not easy to use nor efficient in real time applications. The tools provide no or poor support for knowledge acquisition verification and validation. Although the tools are improving they cannot at the moment replace experience in knowledge engineering. Proper evaluation and documentation of the projects are important in order to bring the experiences gained available for future projects.

47072 US DOE issues NOPI for waste gas reduction with energy conservation. *Journal of the Air and Waste Management Association (USA),* 39(9): 1163-1164 (Sep 1989).

The US Department of Energy (DOE) Office of Industrial Programs, is planning to fund research and development of innovative concepts that will conserve energy in the industrial sector while utilizing, reducing, or eliminating industrial gaseous wastes. Concepts for converting the gaseous waste to any other form for disposal purposes are not acceptable for funding. The term innovative concept is to be interpreted in a very broad sense and includes, but is not limited to: (a) the development of new processes, technologies, materials, or products; (b) The substitution of materials/products; or (c) significant changes to existing manufacturing processes and operations. The innovative concept may be applicable in more than one industry, enhancing the energy savings potential. Proposed concepts must have an annual net energy savings greater than one trillion Btu/year by the year 2010, if implemented on national scale with an appropriate market penetration.

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Refer also to citation(s) 46576, 46658, 46782, 46997, 47045

47073 (DOE/CE/26559–T4) **Ice slurry hydraulic characterization testing of a direct freeze district cooling system: interim report No. 1.** Winters, P.J. Chicago Bridge and Iron Technical Services Co., Plainfield, IL (USA). Aug 1990. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26559. Order Number DE90016300. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The work described in this report was performed by Chicago Bridge & Iron Technical Services Company (CBITS) for the US Department of Energy (DOE). The scope of the current effort (Phase 2) is divided into three separate areas: (1) Ice Slurry Hydraulic Characterization Testing – The objective of this effort is to fully characterize the flow characteristics of an ice slurry system in 3 different pipe sizes and across a wide range of velocities and ice fractions. This work is a direct continuation of the Phase 1 effort, with the inclusion of equipment upgrades and a wider range of test conditions. (2) Ice Slurry District Cooling Feasibility Testing – The objective of this effort is to simulate the real-time operation of a prototype Direct Freeze district cooling system. This work includes the design, construction and operation of a pilot-scale Direct Freeze district cooling system. Variable cooling loads and ice storage capability will combine to simulate a dynamic district cooling network with thermal energy storage for peak-shifting. (3) Final Report With Economic Analysis – The objective of this effort is to document and analyze the technical results obtained and also to discuss the economic impact of these results on a commercial Direct Freeze district cooling system. This report briefly presents the results obtained in the Ice Slurry Hydraulic Characterization Testing. A detailed discussion of these results will be provided in the project final report. 8 figs., 1 tab.

47074 (DOE/CE/26577–T4) **Hospital chilled water loop assessment Miami District Cooling project: Final report.** Burns and Roe, Inc., Oradell, NJ (USA); Joseph Technology Corp., Montvale, NJ (USA). 1 Aug 1990. 233p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE26577. Order Number DE90015520. Source: NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This document is a progress report on a Miami District cooling project for Civic Center Hospitals. An underground distribution system to link the hospitals was devised to minimize capital cost and the maximize savings on operating costs. This study develops a technical and economic analysis and a proposal management structure to provide an equitable distribution of costs and savings. 11 figs., 19 tabs. (FSD)

47075 (EUR–12365) **Recovery of landfill gas: Demonstration project: Final report.** Willumsen, H.C. (Novo Industri A/S, Bagsvaerd (Denmark)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Novo Industri A/S, Bagsvaerd (Denmark). 1989. 141p. (In Danish, English). Sponsored by Commission of the European Communities. Contract BM/741/83-DK. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; Office for Official Publications of the European Communties, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 12.50.

The present report treats of the establishment of a demonstration plant for exploitation of landfill gas, the experience that has been gleaned and the results achieved in this connection. The main objective of the project was to construct a plant which can ensure optimum recovery and exploitation of the landfill gas in small landfills where the filling height is relatively low. Also, the plant should be economically viable. For optimum recovery a special adjustment system was introduced, which has proved very satisfactory, as it has resulted in an increase in the recovered gas volume and ensures a constant methane content. The landfill gas is used in a boiler which supplies heat to Viborg district heating system. Some of the gas is used in a Stirling motor in order to test how this particular motor works on landfill gas. The report contains information about the measuring and registration system of the plant and data derived from the measuring programme. The project has been implemented by Crone & Koch in a close cooperation with the owner of the landfill, Viborg Municipality, and the main contractor, A/S Marius Pedersen. The demonstration project has been granted financial support by the Commission of the EEC (Contract no. BM741/83, "Recovery of Landfill Gas"), and by the Danish Ministry of Energy. 42 figs., 6 tabs.

47076 (NEI-FI–118) **Operation experiences of a low-temperature district heating system in a small-house area.** Maekelae, T. Laempoelaitosyhdistys Ry, Helsinki (Finland). 1989. 20p. (In Finnish). Project KTM-161/881/85. Order Number DE90518700. Source: NTIS (US Sales Only), PC A03/MF A01.

The aim of study was to explain the technical and economical factors concerning a low-temperature district heating system in a small-house area. The study was realized by constructing a low-temperature distribution system in a small-house area locating in the city of Kuopio. The distribution system utilises plastic pipes. The maximum temperature is 70 deg C and the maximum pressure is 0.6 MPa. The construction costs of the distribution system were around 25 per cent lower than those of a traditional system using steel pipes. Relatively the biggest savings were achieved in house branch pipes because of the flexible structure of the pipeline. The operation of the system was followed up during one year. Big operational problems did not occurr. Some problems were, however, affected by the circulating water quality. In the beginning there was corrosion in the system, which affected, that the corrosion products were collected in water meters. The circulating water was treated with an inhibitor, after which the problems diminished. The annual heat loss from the system is 12%. The reason for the relatively small heat loss is the careful dimensioning of the network.

47077 Community Energy Campaigns. McFarland, D. (North Carolina Alternative Energy Corporation, Research Triangle Park (USA)); Dreyfuss, P. pp. 14 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop examines effective ways to develop a community-wide energy conservation campaign. Specifically examined are the experiences of the Community Energy Partnership Program in Massachusettes and the Metropolitan Energy Center in Kansas City. Participants learn about proven, effective programs that involve people in implementing energy conservation improvement in their homes. As a result of this workshop, participants will: (1) Learn about two effective community-wide conservation efforts including current statistical information and studies; (2) Know the different components necessary to develop a program in his or her area; and (3) Be able to begin development of a program in his or her area that combines marketing, audits, financing, contractor selection, and follow-up inspections.

47078 Affordable comfort and affordable payment plans. Esposito, B. (Minneapolis Energy Office, MN (USA)). pp. 20 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Although much time and money is spent on helping clients be more comfortable through conservation (which one hopes lowers their utility bills), all too often what people are actually being billed is overlooked or left to the utility or energy assistance worker. This workshop discusses the importance of integrating budget counseling and bill payment monitoring and feedback as an essential part of any low-income conservation program. A step-by-step process is suggested with the goal of client self-sufficiency. Included is a model contract which can be used by nonprofit groups in cooperation with utilities and community action agencies. As a result of this workshop, participants will: (1) See the essential connection between weatherization, payments and education-client behavior; (2) See a model where a coalition can impact all three and therefore deliver not only affordable comfort but really impact bills and payment.

47079 Materials purchasing: Savings through cooperation. Schiff, J. (GRASP, Philadelphia, PA (USA)); Steele, B. pp. 20 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop presents the financial and programmatic benefits of bulk purchasing programs, offers case studies from programs operated by the Energy Federation in Massachusetts and by GRASP in Philadelphia, and provides how-to information to assist other nonprofits considering starting or expanding bulk purchasing programs. The workshop then discusses possibilities for greater cooperation among nonprofits from different regions. As a result of this workshop, participants will: (1) Be familiar with the bulk purchasing programs operated by GRASP and the Energy Federation and their benefits; (2) Receive information to assist in the establishment of bulk purchasing programs in other regions; (3) Become aware of the possibilities of cooperation among nonprofits on regional and national levels.

47080 Overcoming the split incentive: Marketing to the multifamily sector. Esposito, B. (Minneapolis Energy Office, MN (USA)); Popp, T.; Tooze, D. pp. 24 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The focus of this workshop is marketing; how to get the owners or managers of multifamily buildings to invest in energy conservation. Various models are presented, such as neighborhood meetings and cold calling. The importance of deep financial incentives is emphasized. An analytical approach to retrofit is compared with a hardware approach. As a result of this workshop, participants will: (1) Consider program designs which will lead to successful delivery; (2) Evaluate marketing strategies which get programs into operation; (3) Learn owners' and managers' concerns and what attracts or discourages their participation.

47081 Enhanced incentives: New financing options and partnerships. Groberg, R.P. (Department of Housing and Urban Development, Washington, DC (USA)); Chisolm, N.; Johnston, D.; Hamilton, B. pp. 25 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

New HUD policies permit housing authorities to enter into agreements with private investors for the installation of energy improvements and use the energy savings to pay back the investment. Among sources of help to finance and install these energy improvements are utilities, e.g. Wisconsin Electric Company's zero interest loans and special purpose energy organizations such as

VEIC. As a result of this workshop, participants will: (1) Gain knowledge of the incentives now being offered by HUD to encourage energy investments in public housing; (2) Will hear examples of how utilities and other sources of funds and technical assistance have been employed to secure energy investments in public housing.

47082 **Coalition building.** Sharp, C. (Columbia Gas Company, Columbus, OH (USA)); Steele, B. pp. 26 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Nonprofit organizations can use strategies of effective coalition building with other nonprofits, government entities, and utility companies to design and implement successful conservation programs. Keys to achieving results are understanding the interests of all participants, having a clear focus and objective, and being able to nurture and maintain consensus. As a result of this workshop, participants will: (1) Understand the requirements of developing successful initiatives for new energy programs; (2) Utilize principles of coalition building to meet the individual objectives of an organization, and the collective purpose of a network of organizations; (3) Learn some of the critical criteria that must be analyzed and evaluated if an energy venture is to succeed, as well as have reasons for wanting to succeed.

47083 **Energy-efficient mortgages - home energy rating systems.** Reis, C. (Ohio Department of Development, Columbus (USA)); Curtis, J.; Hall, R.; Faesy, R. pp. 26 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop explains in detail the energy improvement programs of the VA, FHA, Fannie Mae and Freddie Mac which allow a home buyer to roll in the cost of energy improvements into his/her first mortgage at the time of purchase or refinance. The session introduces the Energy-Efficient Mortgage concept as in place in California and Vermont, with particular focus on how energy rating systems can play a role. As a result of this workshop, participants will: (1) Know what the Energy-Efficient Mortgage (EEM) Program is all about; (2) Know how to set up an EEM Program with lenders and realtors; (3) Know what the problems and possibilities of the EEM Program are.

47084 **Measured results from low-income weatherization programs.** Vine, E. (Lawrence Berkeley Laboratory, CA (USA)); Gregory, J.M.; Kushler, M.; Sims, R. pp. 31 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop examines barriers to evaluating low-income weatherization programs and indicate alternative solutions to these barriers. Detailed case studies are presented and analyzed based on programs in Michigan and Ohio. Program energy savings and cost-effective measures are highlighted. The impact of program evaluation on program design and implementation is also discussed. The first, second, and third year savings of a recently-completed study on 1,000 site-built homes are presented in this session. As a result of this workshop, participants will: (1) Identify barriers and strategies in evaluating low-income weatherization programs; (2) Learn about the effectiveness of program evaluation in influencing program design and implementation; (3) Learn about new program designs and delivery systems in low-income weatherization programs.

47085 **Delivering services to the elderly.** Berry, L. (Oak Ridge National Laboratory, TN (USA)); Walsh, J.; McColley, B.; Jones, E. pp. 32 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop begins with an overview of the characteristics of 39 programs designed to meet the energy-related needs of the elderly. This overview is based on a report which presents information on the features that program managers have found to be effective. In addition, program managers from Urban Shelter Associates (Project Warm) and the Arizona Energy Office (Seniors Helping Seniors) discuss the specific features of their programs for the elderly. As a result of this workshop, participants will: (1) Become familiar with the organizational and marketing approaches of 39 programs designed to meet the energy-related needs of the elderly; (2) Recognize the importance of providing client counseling along with weatherization services; (3) See the immediate low-cost benefits of first-line weatherization and of continued partnerships among the public and private sectors and volunteers.

47086 **Advocacy and intervention.** Mulligan, M. (Pennsylvania Public Utility Commission, Harrisburg (USA)); Karp, M.; Morton, J. pp. 32 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop explains the importance of early intervention in rate cases, rule making, and policy decisions that affect low-income households' energy bills. Emphasis is on specific examples of avoiding costs in initiating utility-funded weatherization programs; in role for local agency reps on state and utility advisory councils, in testifying before legislative committees and regulators. Consumers rights handbooks are presented. As a result of this workshop, participants will: (1) Become aware of existing models of advocacy and intervention; (2) Understand the possibilities of early intervention; (3) Be motivated toward future implementation of advocacy and intervention.

47087 **Persistence of energy savings.** Oliver, T. (Bonneville Power Administration, Portland, OR (USA)). pp. 37 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Energy savings have different values depending upon the duration of their effects. Understanding typical modes of savings erosion can help major conservation funding entities design programs that maximize the value of energy savings. Evaluations of current and past programs can quantify the rate and amount of savings erosion. As a result of this workshop, participants will: (1) Understand why persistence of energy savings is important; (2) Be able to identify typical patterns of savings erosion; (3) Understand the role of long-term evaluation in program design and operation.

47088 **Challenges/opportunities: The public housing environmental.** Aldridge, K. (North Carolina Alternative Energy Corporation, Research Triangle Park (USA)); Chisholm, N.; Morgan, S.; Morgan, P.G. pp. 37 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop explores the decision-making environment within public housing. An overview of financial and administrative procedures and case studies reflect the behavioral and organizational dynamics that foster (or hinder) energy efficiency investments. Discussion focuses on the potential for services by outside organizations. As a result of this workshop, participants will: (1) Have a fuller understanding of the administrative, economic and behavioral environment within public housing; (2) Participate in a discussion to identify effective means for outside organizations to provide training and implementation assistance to this sector; (3) Review the status of pending HUD regulatory changes to allow performance financing of energy improvements.

47089 **Utility/nonprofit partnerships.** Dubester, L. (Center for Ecological Technology, Pittsfield, MA (USA)); O'Brien, B. pp. 38 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop emphasizes the amount of time and effort needed to develop a successful residential electric efficiency program. The presenters address the steps involved in program planning and implementation including marketing strategies, eligible measures, incentive payment methodology, technical assessment, financing, contractor selection, quality control and evaluation. The objectives of the workshop are to: (1) Demonstrate that utility companies and community groups can depend on each other's cooperation and resources to develop cost-effective programs; (2) Discuss the program design features marketing technical assistance, contractor participation and quality control; (3) To share the findings to date

including difficulties in program start-up, customer and contractor response.

47090 Working with contractors: Evaluating bids and performance. Crawford, C. (Virginia Association of Community Action Agencies, Richmond (USA)). pp. 45 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial looks at the problems leading to poor quality and provides a practical approach to solving the poor quality dilemma. The session shows that management is the cause of the problem and focuses on how management can effectively control quality. As a result of this tutorial, the participants will: Understand what quality is and how to integrate the philosophy of excellence into their management system.

47091 Marketing energy programs I: The basics. Vories, R. (Infinite Energy, Denver, CO (USA)). pp. 48 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This is a basic introduction or refresher to major marketing principles as they apply to energy efficiency. Part one covers basics of marketing--market research, market strategy, advertising and promotion, and market feedback. Part two is a case study of a conference attendee's program, critiques by participants based on principles presented. As a result of this tutorial, participants will: (1) Be familiar with basic marketing concepts; (2) Be exposed to examples of effective marketing concepts; (3) Be able to determine the type of marketing activity that will be most useful for them for a particular effort.

47092 Building coalitions. Steele, B. (People's Energy Resources Co-op, Framingham, MA (USA)). pp. 51 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Nonprofit organizations can use strategies of effective coalition building with other nonprofits, government entities, and utility companies to design and implement successful conservation programs. Keys to achieving results are understanding participant interests, focusing on a clear objective, and nurturing and maintaining consensus. The tutorial examines case studies, and involves participants in strategic planning exercises involving concrete opportunities for energy organizations. As a result of this tutorial, participants will: (1) Understand the requirements of developing successful initiatives for new energy programs; (2) Utilize principles of coalition building to meet the individual objectives of an organization, and the collective purpose of a network of organizations; (3) Learn some of the essential criteria which must be analyzed if an energy venture is to succeed as well as having reasons for wanting to succeed.

47093 Marketing II: Applying marketing principles. Vories, R. (Infinite Energy, Denver, CO (USA)). pp. 56 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session is designed for those who have extensive experience in marketing. Conference attendees who are beginning to plan new programs are invited to work with the participants in brainstorming an effective approach based on sound marketing principles. As a result of this tutorial, participants will: (1) Have an opportunity to apply basic marketing principles to a real live project; (2) Learn from each other what works and doesn't work; (3) Gain greater understanding of how marketing concepts are applied.

47094 Energy advocacy and intervention. Karp, M. (Opportunity Council, Bellingham, WA (USA)); Mulligan, M.; Morton, J. pp. 59 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop educates those unaware of the importance and possibilities of early intervention in rate cases, rulemaking, and policy decisions that directly and indirectly affect low income households energy bills with a staggering impact. Emphasis is on specific examples of avoiding costs that would have been ratebased and tripled current electric bills; in initiating large scale utility-funded weatherization programs; in possible role for local agency reps on state and utility advisory councils, in testifying before legislative committees, and before regulators. Additionally, consumer rights handbooks developed for local agencies and low-income households relative to educating them on utility structures, language, and issues, are presented. As a result of this tutorial, participants will: (1) Become aware of existing models of advocacy and intervention; (2) Understand the possibilities of early intervention; (3) Be motivated toward future implementation of advocacy and intervention.

47095 Energy-efficient mortgages: Barriers and opportunities. Curtis, J. (Bay Area Energy Consultants, Palo Alto, CA (USA)); Faesy, R.; Hall, R. pp. 67 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial introduces the Energy-Efficient Mortgage concept as used in three locations in California and Vermont. It explains in detail the energy improvement programs of the VA, FHA, Fannie Mae and Freddie Mac which allow a home buyer to roll in the cost of energy improvements into his/her first mortgage at the time of purchase or refinance. Recommendations for implementing an EEM are focused on, based on the presenters' combined experiences. As a result of this tutorial, participants will: (1) Become familiar with three different approaches to energy-efficient mortgages (EEMs), providing financing and upgrading a home's efficiency at the same time; (2) Be presented with experiences in designing, implementing, and operating EEMs; (3) Understand how to mobilize the local shelter industry in setting up and organizing an EEM program.

3209 Education and Public Relations

Refer also to citation(s) 46917, 46919, 46920, 47622

47096 Applying principles of motivation. Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 14 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The purpose of this workshop is to examine the concepts of motivation and explore how we motivate ourselves and other people. Participants are involved in small group tasks, discussions, individual exercises, and total group lecture/dialogue. Information is balanced with experiential involvement to stimulate new insights, enhanced skills, and renew enthusiasm. The objectives for this workshop are to: (1) Examine the concept of motivation; (2) Establish the difference between intrinsic and extrinsic motivation; and (3) Explore some techniques for developing both.

47097 Saving electricity through education. Esposito, B. (Minneapolis Energy Office, MN (USA)); Robinson, L. pp. 16 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop examines how residential electricity conservation can be achieved through the customer's own efforts. Usage patterns and consumer perceptions identified in a study of electrical consumption of low-income in Minneapolis are shared. Two energy education programs are presented and examined. The program models include a utility/partnership between Philadelphia Electric Company and the Energy Coordinating Agency and a pilot electric conservation program in Minneapolis. As a result of this workshop, participants will: (1) Gain a better understanding of residential low-income consumption and consumer myths that can block education efforts; (2) Learn how electricity conservation through education and in-home treatments is being achieved in Philadelphia and Minneapolis; (3) See examples of visual education aids they could apply e.g. prompts, slides, handouts.

47098 Designing evaluations to measure behavioral changes. Dunn, W. (Univ. of Pittsburgh, PA (USA)). pp. 19 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA

(US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session compares, contrasts and evaluates alternative methods for defining and measuring behavioral changes expected as a consequence of energy conservation interventions. As a result of this workshop, participants will: Be able to choose an appropriate strategy for identifying behavioral changes expected as a consequence of energy conservation interventions.

47099 Targeting the critical decision-maker: Training the building owner and manager. Post, L. (Wisconsin Energy Conservation Corporation, Madison (USA)); Aldridge, K. pp. 19 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

When participants enter the meeting room, they shed their true identity and became the owner, manager, or maintenance staff of a multifamily building. They used their personal experience, imagination, and a supplied biographical sketch to put themselves in the shoes of the person they were portraying. In this role they learned to understand the need and goals of these individuals and what motivates them, enabling them to produce a training component designed to achieve a positive response. As a result of this workshop, participants will: (1) Be aware of some of the personal and professional objectives that motivate building owners, managers and maintenance staff; (2) Understand what motivates these individuals; (3) Have many of the tools necessary to design a multifamily program training component.

47100 Measuring results: Low-income consumer education programs. Harrigan, M. (Alliance to Save Energy, Washington, DC (USA)); Collins, N.E.; Lent, T. pp. 21 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop explores what is known about the ability of energy education to improve the savings resulting from conservation programs. The state of energy education evaluations and present case studies are discussed. Participants learn how to evaluate the impact of education in their own program. As a result of this workshop, participants will: (1) Learn about the impact of education on the energy bills of participants in the federally-funded weatherization program as measured in a case study (ECA 1987 study); (2) Learn what others around the country have done to implement and measure the impact of energy education programs (ASE overview study in progress); (3) Discover how they can measure the impact of education in their own programs.

47101 Effective consumption feedback to consumer education programs. Lent, T. (Energy Coordinating Agency, Philadelphia, PA (USA)); Cal, J.; Kempton, W. pp. 27 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop describes a new type of utility program, a weather- and price-adjusted Energy Report to the customer. National Fuel describes their experience from sending out such reports annually to their entire customer base. Princeton University describes their experiments in developing reliable and readable reports, and analyzing customer reactions to them. The Energy Coordinating Agency comments from a weatherization program perspective. As a result of this workshop, participants will: (1) Understand how to implement a consumption feedback program in their utility; (2) Be able to evaluate the potential impacts of consumption feedback on other utility programs: demand-side management, audits, customer service; (3) Weatherization program managers will be prepared to utilize utility-provided consumption feedback, either to evaluate weatherization effectiveness or as a component of client education program.

47102 Developing and critiquing energy education resources. Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 33 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Energy education resources include anything one can use to increase the knowledge, understanding, positive attitude, and/or skills of targeted learners - films, tapes, video tapes, printed materials, demonstration equipment, peer testimonials, utility bills, utility meters, houses, windows, doors, etc., etc., etc. - and people, especially the learners. This workshop examines a wide range of resources and work on how to select the most useful for different learners, and on how to develop printed material. As a result of this workshop, participants will: (1) See a wide range of energy education resources; (2) Examine methods of critiquing resources to achieve education effectiveness for targeted participants; (3) Discuss the process for developing printed material - from concept to product.

47103 Models for low-income, home-based energy education. Kloepfer, M. (ACTION-Housing, Inc., Pittsburgh, PA (USA)); Luken, S. pp. 39 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

How to be effective as a home educator is the focus of this workshop. It addresses such issues as family involvement in the education process, personalized education plans, possible funding sources, necessary traits in a home education and underlying issues facing low-income families which influence the effectiveness of the education component. Participants experience materials and gain practical insights into the challenges of the home situation as a viable education strategy. As a result of this workshop, participants will: (1) Join in a discussion of issues and problems encountered in home education; (2) Experience and analyze educational materials developed by ACTION-Housing and Mid-Ohio Regional Planning Commission as part of their home-based energy education programs; (3) Recognize underlying issues which need to be addressed in order to do effective low-income energy education.

47104 Planning an energy education program. Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 47 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The authors reviews the basic goals and objectives of a client-customer energy education (CEE) program; examines the essential elements of effective CEE; and applies the planning process to CEE. Participants are totally involved to focus their experience, knowledge and skills on this topic. The objectives for this tutorial are to: (1) Review the goals and objectives of a low-income energy education program; (2) Apply the planning process to energy education; (3) Expand our understanding of energy education's essential components: reliable content, motivation techniques, communication skills and adult education theory.

47105 Building on client/customer value systems. Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 52 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This session offers experiences to heighten awareness of value systems and examine how they affect the expectations people have of themselves and others. One can use this awareness as a tool for addressing conflict situations. The objectives for this tutorial are to: (1) Discuss the impact that personal and cultural values have on behavior; (2) Clarify some of our values and their relation to our energy-usage behavior; (3) Develop some approaches for understanding and appreciating different value systems.

47106 Community-based approaches to energy education. McFarland, D. (North Carolina Alternative Energy Corporation, Research Triangle Park (USA)). pp. 60 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

The goal of this workshop is to help emphasize the development of partnerships in the local community, to help with project planning and implementation, to increasing the overall awareness of energy efficiency and establishing energy efficiency as an ongoing theme in the community. As a result of this tutorial, participants will: (1) Learn about alternative marketing strategies for residential

conservation programs; (2) Be exposed to successful examples of program design, implementation, and evaluation; (3) Discuss a model for other communities to adopt to effectively increase energy conservation activities in the residential sector.

47107 **Communication skills.** Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 60 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

Good communication is the foundation of effective staff relations, productive organizations and rewarding client/customer efforts. This tutorial provides information, experiences and practice sessions to help participants identify style, language and attitudes that can improve communication dramatically. The objectives for this tutorial are to: (1) Heighten awareness of the impact our communication style has on our work; (2) Investigate skills needed by Senders and by Receivers; (3) Practice applying selected improvement tactics.

47108 **Team building I: Concepts and theory.** Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 64 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial covers the basic theories of M-I-T, team effectiveness, and leadership styles. It provides a down-to-earth, practical foundation for anyone who has a leadership role who wants to improve a group's functioning. The objectives of this tutorial are to: (1) Understand the three common needs of all task-oriented groups/teams; (2) Outline the elements contributing to team effectiveness; (3) Evaluate the strengths and weaknesses of different leadership styles.

47109 **Team building II: Implementation skills.** Gill, L. (Constructive Consulting, Oklahoma City, OK (USA)). pp. 71 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial builds on the foundation laid in the morning tutorial, Team Building I. The participants determine which skills/topics receive most attention - communication, decision-making, problem solving, or goal setting. A primary purpose is to provide experiences that participants can replicate with their back home work groups. The objectives of this tutorial are to: (1) Practice applying the skills needed for team building; (2) Gain experiences that can be used with back home work groups; (3) Enhance our understanding of group decision making, problem solving and goal setting.

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 47113, 47114

47110 (PB--90-247370/XAB) **Endurance testing of an automotive-derivative natural-gas engine. Topical report, May 1990.** TECOGEN, Inc., Waltham, MA (USA). May 1990. 95p. Contract GRI-5087-293-1451. (TR--7020-149-89). Source: NTIS, PC A05/MF A01.

The report describes the results of endurance testing a number of light-duty gas engines at various speeds and loads. The subject engines were all 454 cubic inch displacement automotive gasoline engines converted to operate on natural gas. Both naturally aspirated and turbocharged engines were tested. The results include performance, oil consumption, and blow-by for the duration of the tests. Lubricating oil analyses for the duration of the tests are also presented. Wear rates of critical engine components are shown and analysis of failed components is presented.

3303 Electric-Powered Systems

47111 (LBL--29078) **Zinc air battery development for electric vehicles: Final report.** Putt, R.A. (Metal Air Technology Systems International, Inc., Lawrenceville, GA (USA)). Lawrence Berkeley Lab., CA (USA); Metal Air Technology Systems International, Inc., Lawrenceville, GA (USA). May 1990. 27p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. Order Number DE90016639. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document reports the progress and accomplishments of a 16 month program to develop a rechargeable zinc-air battery for electric vehicle propulsion, from October 1988 through January 1990. The program was the first stage in the transition of alkaline zinc electrode technology, invented at Lawrence Berkeley Laboratory, to private industry. The LBL invention teaches the use of a copper metal foam substrate for the zinc electrode, in combination with forced convection of electrolyte through the foam during battery operation. Research at LBL showed promise that this approach would avoid shape change (densification and dendrite growth), the primary failure mode of this electrode. The program comprised five tasks; (1) cell design, (2) capacity maximization, (3) cycle testing, (4) materials qualification, and (5) a cost/design study. The cell design contemplates a plate and frame stack, with alternating zinc and oxygen electrode frame assemblies between rigid end plates. A 200 Ah cell, as may be required for the EV application, would comprise a stack of five zinc and six oxygen electrode frame/assemblies. 8 figs., 2 tabs.

3306 Vehicle Design Factors

Refer also to citation(s) 46794, 47115

3308 Alternative Fuels

47112 (DOE/MC/10637--2803, pp. 21, Paper 11) **Diesel utilization of low-rank coals.** Collings, M.E.; Swanson, M.L.; Mann, M.D. North Dakota Univ., Grand Forks, ND (USA). Energy and Mineral Research Center. [1989]. In *Low-rank coal research. Quarterly report, October 1988--December 1988.* Order Number DE90014270. Source: NTIS, PC A22/MF A01.

The overall objective of this program is to develop a scientific and engineering data base on the utilization of subbituminous and lignitic coals (LRCs) for emerging heat engine technologies involving diesel engine applications. Research will be directed toward understanding the characteristics of LRC fuels produced from existing and advanced beneficiation processes. Combustion studies will provide an understanding of functional relationships between fuel properties and the products of combustion, including the release and deposition of alkali metals and other ash constituents. The formation of nitrogen and sulfur oxides and other potential environmentally detrimental species will be investigated, along with methods to reduce their emission levels. The impact of LRC fuels on diesel engine components including injection systems and combustion chambers will also be studied. The investigation of diesel engine utilization of LRCs at UNDEMRC is a multi-year program. Three-year goals were established at the beginning of the program, but were modified at the start of the second program year in response to DOE directions and changes in funding level. The current emphasis of the project is to study the characteristics of diesel performance using LRC-derived fuels and to optimize the diesel system for use with these fuels. The modified three-year goals are discussed in the following text.

47113 (EUR--12280) **An emulsion of diesel oil and water to fuel urban public transportation: Demonstration project.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Agip-Petroli, Rome (Italy). 1989. 93p. (In English, Italian). Sponsored by Commission of the European Communities. EE/134/85-1. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The purpose of the project was to install a diesel oil and water emulsion system in diesel engines for use on urban public transportation vehicles to test abatement of pollutant exhaust and reduction in fuel consumption. The test was carried out on a significant number of vehicles equipped with the emulsion system and on conventional vehicles as well, for purposes of comparison. The

reason for testing the advantages of the system on public transport vehicles was the particular way the engines work on these vehicles: extremely variable speed; frequent stops; and heavy loads. This report gives the results of the testing. 13 figs., 8 tabs.

47114 (EUR–12306) **Investigations of unleaded fuels for Otto-engines with different octane number improving components with respect to knocking, fuel consumption and exhaust emissions: Final report.** May, H. (Kaiserslautern Univ. (Germany, F.R.). Lehrstuhl fuer Kraft- und Arbeitsmaschinen); Hattingen, U.; Weidenhoeft, D. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1989. 70p. Sponsored by Commission of the European Communities. EN 3C-0044-D(B). Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 6.25.

In introduction of unleaded fuels in the European Community has lead to a decrease in knock stability for the premium gasoline quality. Knock resistance characterized by the Research Octane Number RON and the Motor Octane Number MON decreased from RON 98 to RON 95 and from MON 88 to MON 85. Coincidently a decrease in fuel economy and power output of modern engines at certain operating conditions due to knocking problems had to be taken into consideration. In this context the scope of the current research program, discussed herein, was how much the knock resistance of unleaded fuels could be improved by addition of alcohols and alcohol derivates to get better fuel economy and power output. The aim was not only to cover the above mentioned losses but to get even better fuel economy compared with the former results corresponding to a premium gasoline quality of RON 98. In this context it was also investigated to which extent it was possible to get a decrease of noxious exhaust gas emissions in addition. 62 refs., 38 figs.

47115 (PB–90-239914/XAB) **Economic analysis of low-pressure natural-gas-vehicle storage technology. Task 3 topical report, March 1989-April 1990.** Biederman, R.T.; Blazek, C.F. Institute of Gas Technology, Chicago, IL (USA). Apr 1990. 91p. Contract GRI-5086-530-1365. Source: NTIS, PC A05/MF A01.

The economic analysis concludes that, under the assumptions of the base case, a low pressure adsorbed natural gas (ANG) system for vehicle fuel storage is a viable and competitive alternative to compressed natural gas (CNG) storage systems. ANG systems offer the ability to reduce compressor capital and operating costs, and eliminate costs associated with periodic recertification of CNG storage cylinders. The only cost element to realize and increase due to ANG is the vehicle fuel storage apparatus. Specifically, the cost for purchasing adsorbent carbon becomes the most significant additional expenditure.

35 ARMS CONTROL

47116 (AD-A–222248/7/XAB) **Crisis communications between superpowers. Individual study project.** Thacher, S.L. Army War Coll., Carlisle Barracks, PA (USA). 12 Feb 1990. 32p. Source: NTIS, PC A03/MF A01.

Ever since the United States and the Soviet Union first possessed the ability to destroy each other with nuclear weapons, they have been looking at means to defuse crisis situations and avoid inadvertent nuclear warfare. One of the means that evolved was the Washington-Moscow Hotline, put into operation on August 31, 1963. This was the first crisis communications system, ever, between superpowers and the first bilateral arms control agreement. Over the past twenty-seven years, this and other crisis communications systems have evolved and others have been recommended. Information was gathered using a review of the literature and through analysis of the views of key military and civilian leaders. Although opponents have many reasons for opposing crisis communications systems, the evidence supports the position that these systems have been a deterrent to war and that further improved crisis communications systems between the superpowers would be advantageous as we move into the 1990's.

47117 (AD-A–222352/7/XAB) **Domestic implementation of a chemical weapons treaty. Interim report.** Arcesty, J.; Wolf, K.A.; River, E.C. Rand Corp., Santa Monica, CA (USA). Oct 1989. 143p. Contract MDA903-85-C-0030. (RAND/R–3745-ACQ). Source: NTIS, PC A07/MF A01.

To determine the effects on and the role of industry in the event of implementation of a chemical weapons treaty, this report analyzes the way in which the proposed treaty can mesh with the U.S. regulatory system, examines whether and how existing reporting and inspection requirements or regulations can be used to facilitate domestic implementation, studies the domestic implementation procedures and experience gained from the U.S. International Atomic Energy Agency Safeguards Agreement, and develops some general observations and recommendations pertaining to legislative and regulatory approaches to U.S. treaty implementation.

3501 Policy, Negotiations, and Legislation

47118 (LA–11834-MS) **Arms control and the 1990 NPT review conference: Workshop summary: CNSS [Center for National Security Studies] Occasional Paper No. 25.** Pilat, J.F. Los Alamos National Lab., NM (USA). Jul 1990. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90016656. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Center for National Security Studies of the Los Alamos National Laboratory and the Department of Energy's Office of Arms Control held a workshop on "Arms Control and the 1990 NPT Review Conference" on December 5–6, 1989, at Los Alamos. The fundamental objective of the Treaty on the Nonproliferation of Nuclear Weapons (NPT) is to prevent the spread of nuclear weapons to states that do not possess them; however, another of the NPT objectives is to encourage arms control efforts in the nuclear and nonnuclear arenas. Accordingly, under Article VI, "each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." This paper discusses ideas put forward at the Review Conference.

47119 (UCRL-LR–103710) **START [Strategic Arms Reduction Talks] and stability.** Reinhardt, G.C. Lawrence Livermore National Lab., CA (USA). 15 May 1990. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016650. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this study, which extends our investigations of prevenient stability, we examine the effects of strategic arms reductions such as those proposed in the Strategic Arms Reduction Talks (START). We use exchange models and the theory of prevenient stability to look at the changes in crisis stability and deterrence that would be brought about by future cuts in the strategic nuclear forces of the US and the USSR. Our analysis includes strategic defenses and hypothetical technological breakthroughs. Our results indicate that, if force vulnerabilities exist on either side, arms reductions would erode deterrence – the greater the degree of vulnerability, the greater the effect. Defense of strategic strike forces, if perfected, would improve deterrence and increase crisis stability. Otherwise, it is clear that prevenient stability, as explicitly defined herein, would be decreased. 9 refs., 3 figs., 7 tabs.

3502 Proliferation

47120 (AD-A–222311/3/XAB) **Chemical weapons proliferation in the Middle East. Study project.** Schumeyer, G. Army War Coll., Carlisle Barracks, PA (USA). 1 Apr 1990. 60p. Source: NTIS, PC A04/MF A01.

Since the early 1980s, chemical weapons proliferation in the Middle East has been a growing problem. Most recently, the eight year Iran-Iraq War, marked by the repeated use of chemical weapons, has set an alarming precedent in this region that can no longer be ignored. The threat is acute and the implications for the Middle East, an area where animosities are high and relations

tense, are significant. The study will address chemical weapons proliferation in the Middle East. It will examine why proliferation occurred and look at initiatives and efforts to prevent proliferation. This study will also discuss the chemical weapons capabilities of the Middle East states, the threat to the region posed by chemical weapons, and some of the implications for balance and stability in the region. Finally, this study will examine future prospects for the region in terms of chemical weapons proliferation there.

3503 Verification

Refer also to citation(s) 47480, 47494

47121 (LA–11911-MS) **A conceptual framework for verifying the multinational Chemical Weapons Convention: CNSS [Center for National Security Studies] Occasional Paper No. 26.** Apt, K.E. Los Alamos National Lab., NM (USA). Aug 1990. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90016657. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The United States has for several years sought an effective, global ban on the production, possession, and use of chemical weapons (CW). In 1984, then-Vice President Bush submitted to the ongoing Conference on Disarmament in Geneva a draft comprehensive Chemical Weapons Convention (CWC); since then, he has supported the multinational process for CWC implementation. Given the high visibility of a CW treaty, policy makers face some major questions. Is such a treaty more valuable to national security than a chemical deterrent capability? How useful will the treaty be if key nations or geographical regions are not covered? How useful will the treaty be if key nations or geographical regions are not covered? What constitutes an effective CWC verification regime, and can the objectives of this regime be achieved? How would signatories respond to noncompliance by other signatories? The answers to such questions will be important in determining the level of support, both nationally and internationally, for the multinational CWC. In addressing the issue of effective verification, it is important to consider how the CWC objectives devolve into general requirements for the verification regime. Translating these requirements into specific monitoring and inspection activities helps in understanding the extent and limitations of effective CWC verification. 4 refs.

36 MATERIALS

47122 (UCID–20622-88-2) **Chemistry and materials science research report: Second half FY 1988.** Lawrence Livermore National Lab., CA (USA). 16 Nov 1988. 70p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016677. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Basic and applied research in the Chemistry and Materials Science Department is carried out under the auspices of Weapons-Supporting Research (referred to as Chemistry Research Resource, or CRR) and the departmental Institutional Research and Development program. These activities tend to have longer-term goals than those funded directly by Laboratory programs. The report is divided into three sections describing activities in seven areas, the individual CRR projects, and the departmental IR&D projects. Areas are: high-temperature superconductors; tritium; high explosives; advanced characterization; interfaces; adhesion and bonding; advanced synthesis and processing; plutonium and actinides.

47123 (VTT-PUB–S62) **Abrasion of concrete by ice in arctic sea structures.** Huovinen, S. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Poltto- ja Voiteluainelab.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1990. 145p. Order Number DE90518698. Source: NTIS (US Sales Only), PC A07/MF A01.

In arctic sea regions a concrete sea structure is subjected to heavy mechanical loads near the water level due to the moving ice sheets. Moving ice sheets load protruding aggregate stones, and the loads are considerably greater than the compressive strength of ice as determined in uniaxial compressive tests. This is due to the triaxial compression stress in the ice surrounding the stone surface. Also, recurrent freeze-thaw cycles in the concrete wetted by waves and the tide expose the concrete to damage if it has not been designed to resist recurrent freezing in marine conditions. Temperature changes that exceed the approximate value $\Delta = 40$ deg C also deteriorate the bond between the cement stone and the stones and increase cracking in the cement stone between the aggregate stones. The determination of the abrasion depth is based on laboratory tests for measuring ice pressures against protruding aggregate stones, laboratory tests for determining the strength values of concrete after freeze-thaw cycles in sea water, abrasion tests with an abrasion machine, abrasion tests with an icebreaker at sea, abrasion studies on Finnish lighthouses and computer calculations. The best resistance to abrasion of concrete is achieved by preventing frost damage, by keeping the concrete either so warm or so frozen at the water level that it is not exposed to freeze-thaw cycles. Also the use of hard homogeneous concrete in the ice abrasion zone reduces abrasion because the surface is subjected to uniform abrasion and there are no detaching stones. Also increasing the maximum size of the aggregate reduces the abrasion because large stones protruding from the concrete surface break the ice before it affects the finer concrete substances.

3601 Metals and Alloys

Refer also to citation(s) 46370, 46639, 46641, 46664, 46734, 46735, 46736, 46737, 46825, 46826, 46837, 46841, 46860, 46864, 46899, 46900, 46901, 46902, 47198, 47202, 47215, 47229, 47235, 47239, 47287, 47295, 47297, 47300, 47301, 47303, 47319, 47345, 47346, 47347, 47348, 47349, 47350, 47358, 47367, 47369, 47370, 47430, 47460, 47485, 47937, 47938, 48039, 48041, 48043

47124 (AD-A–222432/7/XAB) **Passive mechanisms of surfaces produced by ion-beam mixing and ion implantation. Annual report, October 1988-November 1989.** Natishan, P.M.; McCafferty, E.; Hubler, G.K. Naval Research Lab., Washington, DC (USA). May 1990. 27p. (NRL-PUB–167-6320). Source: NTIS, PC A03/MF A01.

The corrosion behavior of Mo-Al, Cr-Al and Cr-Mo-Al surface alloys produced by ion implantation and ion beam mixing was examined in deaerated, 0.1M NaC1. The polarization behavior of the ion implanted samples was similar to that of Al and the pitting potentials of the ion implanted samples were 115 to 155 mV higher than that of Al. From the standpoint of the Ph sub pzc model this behavior would be explained by the presence of the implanted cations in the stable oxide lattice. There was incomplete mixing of the coating and substrate for the ion beam mixed samples, and the mixed elements remained almost entirely in the metallic state so that the desired mixed oxide films were not formed. Ion beam mixing did impart additional stability compared to as-deposited samples since themixing process produced more compact coatings.

47125 (BNL–44434) **XAFS studies of interactions at transition-metal/Al interfaces.** Heald, S.M.; Barrera, E.V. Brookhaven National Lab., Upton, NY (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016 ;AS05-80ER10742. (CONF-9008141–1: 6. international conference on XAFS meeting, York (UK), 5-11 Aug 1990). Order Number DE90016313. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

XAFS measurements on transition metal/Al interfaces have been made using a combination of glancing angle and in-situ UHV techniques. Glancing angle methods provide depth dependent interface structural information for Al on metal bilayers, while SEXAFS methods were used for thin metal layers on Al substrates. In all cases studied (Ni, Cu, and Cr) interfacial O played a crucial role in determining the interface structure. 4 refs., 2 figs.

47126 (CEA-CONF–10132) **Creep corrosion behaviour of welds in alloy 800 H and 316L and in several experimental ferritic stainless steels.** Lefort, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (FR)); Bressan, J.; Franzoni, U. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). 1990. 29p. (CONF-900206–11: 119. TMS (The Minerals, Metals & Metallurgical Society) annual meeting and exhibit, Anaheim, CA (USA), 18-22 Feb 1990). Order Number DE90518442. Source: NTIS (US Sales Only), PC A03/MF A01.

For the temperatures (<700°C) and exposure times considered, coal gasification type atmospheres have little effect on the creep behaviour of iron-based materials such as alloy 800 H, 316 L stainless steel or chromium, titanium and aluminium containing ferritic grades. While the rupture elongation is decreased, the creep rate and rupture life remain relatively unaffected. However, special care must be taken with welds, since the inconel 82 filler metal used with alloy 800 H is particularly prone to attack and must be replaced by another material, alloy N155, less rich in nickel. 8 refs., 18 figs.

47127 (CEGB-RD/B–6231-R89) **A review of the rates of reaction of unirradiated uranium in gaseous atmospheres.** Pearce, R.J. Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs. Oct 1989. 92p. Order Number DE90638119. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The review collates available quantitative rate data for the reaction of unirradiated uranium in dry and moist air, steam and carbon dioxide based atmospheres at temperatures ranging from room temperature to above the melting point of uranium. Reactions in nitrogen and carbon monoxide are also considered. The aim of the review is to provide a compilation of base data for the hazard analysis of fault conditions relating to Magnox fuel. (author).

47128 (CONF-900632–1) **Brittle fracture and ductility improvement in nickel and iron aluminides.** George, E.P.; Liu, C.T. Oak Ridge National Lab., TN (USA). [1990]. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Meeting of the International Materials Research Society; Beijing (China); 18-22 Jun 1990. Order Number DE90017319. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nickel and iron aluminides are two potentially useful ordered intermetallic alloy systems that share a problem common to many ordered intermetallics, namely brittle fracture and poor ductility at room temperature. However, recent developments have shown that it is possible to overcome this problem and get significantly improved room-temperature ductilities in both these alloy systems by employing a combination of micro-and macro-alloying techniques. Concurrently, our understanding of the underlying causes of brittle fracture in ordered intermetallics has improved dramatically. We review here recent results related to the ductility and fracture behavior of two nickel aluminides (Ni_3Al and NiAl), and two iron aluminides (FeAl, and Fe_3Al). We will show that the major difference between Ni_3Al and the two iron aluminides is the following: in the former, brittle fracture is a result of intrinsically weak grain boundaries, whereas in the latter, brittle fracture is a result of an extrinsic factor, namely moisture-induced environmental embrittlement. The brittleness of Ni_3Al can be overcome by microalloying with boron and carefully controlling the alloy stoichiometry, whereas the ductilization of iron aluminides requires modification of their surface composition (or environment) to minimize the chemical reaction with moisture in air. NiAl also has weak grain boundaries (like Ni_3Al), which can be strengthened by the addition of small amounts of boron. However, because of its other problems, like poor cleavage strength and insufficient number of deformation modes, the ductility of NiAl is not significantly improved even after intergranular fracture is totally suppressed. 71 refs., 5 figs., 2 tabs.

47129 (CONF-900830–1) **Substrate temperature effects on ($\sqrt{3}\times\sqrt{3}$) R30° domain growth of Ag on Si(111) surface.** Zuo, J.K.; Wendelken, J.F. Oak Ridge National Lab., TN (USA). Aug 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 5. international conference on solid films and surfaces; Providence, RI (USA); 13-17 Aug 1990. Order Number DE90016527. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High-resolution LEED angular profiles associated with ($\sqrt{3}$ x $\sqrt{3}$)R30° domain growth of Ag on Si(111) have been analyzed following Ag deposition as a function of substrate temperature. We found that the $\sqrt{3}$ domain size distribution has the same Gamma distribution at different coverages and substrate temperatures. However, at higher substrate temperatures the $\sqrt{3}$ structure grows with coverage primarily by domain coalescence as indicated by the considerable increase in the mean and width of the size distribution. As a result, scaling, i.e. self-similar domain growth, is observed. At lower substrate temperatures the $\sqrt{3}$ structure grows with coverage by simply increasing the number of small, randomly nucleated domains. Hence, the domain size distribution at low temperatures is narrow and varies little with coverage. 18 refs., 3 figs.

47130 (DOE/ID/12655–2) **Long-term testing of in-situ cerium oxide coated anodes for aluminum electrowinning: Phase 2: Final report, December 1, 1987–April 30, 1989.** King, H.L. ELTECH Research Corp., Fairport Harbor, OH (USA). Oct 1989. 116p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-86ID12655. Order Number DE90015283. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The ELTECH Anode Phase 2 Project (Contract Number AC07-86ID12655), as supported by the Department of Energy (DOE) from December 1988 through April 1989, focused on long-term testing of in-situ anodically deposited cerium oxide (CEROX) coatings on nickel ferrite/Cu cermets. The specific objective of this research was to determine the effectiveness of the CEROX coating in reducing the transfer of cermet components to the produced aluminum. A dosing regimen was first established for the minimum addition of cerium to the cell necessary to produce targeted CEROX coatings on the cermet anode and the periodic additions necessary to maintain coating thicknesses. The effects of the addition of CeF_3 on CEROX coating formation was evaluated for targeted coating thicknesses at three different current densities. Analytical procedures were identified for determining alumina concentrations and the cryolite bath ratio for quasi-commercial baths.

47131 (ESTD-L–0072/R89) **Limits to the adherence of oxide scales.** Robertson, J.; Manning, M.I. National Power, Leatherhead (UK). Oct 1989. 28p. (CIF/CCWG/P–(89)11). Order Number DE90639508. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Fracture mechanics is used to identify criteria under which uniform oxide scales may be expected to fail due to rapidly applied strains. The most common failure mode occurs when the strain, ϵ, builds up in the scale until the strain energy density per unit area exceeds the fracture surface energy, γ, of the oxide. This produces spalling when $\epsilon > (2\gamma/hE)^{1/2}$, where h is the scale thickness and E is the oxide Youngs modulus. In thin scales, as the external strain is applied to the oxide via the metal substrate, it is clear that no further strain can be applied to the oxide if the substrate has itself been strained beyond yield. This gives rise to extended oxide adherence in which the oxide cracks and forms a series of islands but remains attached to the deformed metal. When the oxide thickness is less than its comminution limit, the flaw size necessary for brittle fracture exceeds the oxide thickness and the oxide yields in a ductile manner without cracking. The results are presented as maps of failure strain versus oxide thickness for various oxide systems such as Fe_3O_4, Cr_2O_3, Al_2O_3, SiO_2 and NiO. The observed cases of spalling are found to lie within the predicted regions. (author).

47132 (IS-T–1486) **Characterization of mono- and multimolecular assemblies at glassy carbon and noble metals by ex situ and in situ infrared external reflection spectroscopy.** Stole, S.M. Ames Lab., IA (USA). 23 Aug 1990. 199p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90016417. Source: NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This dissertation describes the utilization of infrared external reflection spectroscopy (IR-ERS) as a means of elucidating many of the properties of polymer films and mono- and multimolecular films at both semiconducting glassy carbon and conducting noble metal surfaces. Infrared external reflection spectroscopy was utilized to monitor the hydrolysis of the film as the molecular composition changed from the acetate to the cellulosic form. The electrochemical measurements indicate a change in perselectivity as the hydrolysis proceeds. The effects of a variety of solvents on the integrity and orientation of an n-alkanethiol monolayer were studied by IR-ERS without the necessity for modulation methodologies. This dissertation reports the first in situ infrared external reflection spectra for an n-alkanethiol monolayer at Au and Ag in the presence of a variety of solvents without the need for potential or polarization modulation. Descriptions provided by such measurements promise to expand the understanding of the fundamental intermolecular

forces that control the chemical and physical properties of these interfaces. Further, this technique has far-reaching applicability to a variety of other interfacial systems with varying properties.

47133 (LA-UR–90-2677) **Shock experiments in metals and ceramics.** Gray, G.T. III. Los Alamos National Lab., NM (USA). [1990]. 15p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-9008125–6: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016613. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Shock recovery and spallation experiments, in which material structure/property effects are systematically varied and characterized quantitatively, offer two important experimental techniques to probe the physical mechanisms controlling shock processes and dynamic fracture. This paper highlights the current state of knowledge and principal challenges of the structure/property effects of shock-wave deformation on metals and ceramics. Recent shock-recovery and spallation experimental results on post-mortem material properties and fracture behavior in metals and ceramics are reviewed. Finally, the influence of shock-wave deformation on several intermetallics and a recent experiment examining the Bauschinger effect in Al-4% Cu during shock loading are presented. 65 refs., 6 figs.

47134 (LA-UR–90-2678) **The influence of shock pre-strain and peak pressure on spall behavior of 4340 steel.** Zurek, A.K.; Frantz, C.E.; Gray, G.T. III. Los Alamos National Lab., NM (USA). [1990]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9008125–7: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016612. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A fundamental study of the influence of peak stress amplitude and pre-strain on the spall fracture of pearlitic 4340 steel is presented. Spall tests were performed at projectile velocities to achieve approximately 5, 10 and 15 GPa peak stress amplitudes. Some spall tests were preceded by a pre-shock and recovery test at 10 and 15 GPa. Spall strength measurements suggest that there is a decrease in the spall strength of 4340 with an increase in the shock wave amplitude as the transition pressure of 13.1 GPa is approached. At this transition pressure, a substantial increase in the spall strength, as well as a change in a mode of fracture from brittle to ductile are observed, both attributed to the allotropic phase transformation at this amplitude. 18 refs., 4 figs.

47135 (LA-UR–90-2679) **Texture-induced anisotropy and high-strain rate deformation in metals.** Schiferl, S.K.; Maudlin, P.J. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9008125–8: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016611. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have used crystallographic texture calculations to model anisotropic yielding behavior for polycrystalline materials with strong preferred orientations and strong plastic anisotropy. Fitted yield surfaces were incorporated into an explicit Lagrangian finite-element code. We consider different anisotropic orientations, as well as different yield-surface forms, for Taylor cylinder impacts of hcp metals such as titanium and zirconium. Some deformed shapes are intrinsic to anisotropic response. Also, yield surface curvature, as distinct from strength anisotropy, has a strong influence on plastic flow. 13 refs., 5 figs.

47136 (LA-UR–90-2688) **Magnetism and bonding in actinide and rare earth systems.** Eriksson, O. (Los Alamos National Lab., NM (USA)); Albers, R.C.; Boring, A.M.; Brooks, M.S.S.; Johansson, B. Los Alamos National Lab., NM (USA). [1990]. 20p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-901004–3: Conference on magnetism and magnetic materials, San Diego, CA (USA), 30 Oct - 2 nov 1990). Order Number DE90016571. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The importance of including all of Hund's rules in self consistent electronic structure calculations is pointed out. We present a scheme that accounts for the interactions that lead to these rules, and we give examples of when these interactions become important. Calculated ground state properties (chemical bonding, magnetic moment, magnetic form factor) of actinide and rare earth systems are found to agree better with experiment when all Hund's rules are accounted for. On the other hand, for Fe, Co and Ni we find that it is a reasonable approximation to neglect Hund's second and third rule. 20 refs., 5 figs., 3 tabs.

47137 (LA-UR–90-2801) **Mechanical and microstructural response of Ni_3Al at high strain rate and elevated temperatures.** Sizek, H.W.; Gray, G.T. III. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900818–4: International conference on shock wave and high-strain-rate phenomena in materials, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016489. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, the effect of strain rate and temperature on the substructure evolution and mechanical response of Ni_3Al will be presented. The strain rate response of Ni_3Al was studied at strain rates from 10^{-3} s^{-1} (quasi-static) to 10^{4} s^{-1} using a Split Hopkinson Pressure Bar. The Hopkinson Bar tests were conducted at temperatures ranging from 77K to 1273K. At high strain rates the flow strength increased significantly with increasing temperature, similar to the behavior observed at quasi-static rates. The work hardening rates increased with strain rate and varied with temperatures. The work hardening rates, appeared to be significantly higher than those found for Ni270. The substructure evolution was characterized utilizing TEM. The defect generation and rate sensitivity of Ni_3Al are also discussed as a function of strain rate and temperature. 15 refs., 4 figs.

47138 (LBL–26455, pp. 1) **Structure and properties of transformation interfaces.** Gronsky, R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The modern science of materials devotes increasing attention to the role of solid-state interfaces; they completely dominate the behavior of thin-film electronic devices, and they strongly influence the behavior of composite materials as well as bulk ceramic and metallic alloys. This program seeks a fundamental understanding of the role of interfaces in materials by applications of high-resolution electron microscopy to determine local interfacial structure and composition, by theoretical modeling to relate these parameters to actual atomic structure and composition, and by correlations with interfacial-specific properties, including conductivity, diffusivity, ductility, mobility, and reactivity. Significant attention has been given this past year to various interfaces in the new high-T_c superconductor materials. Planar defects, twins, and grain boundaries are examples of internal interfaces that act as rather serious obstacles to the commercial implementation of these materials, no matter how high their critical temperatures. The continued emphasis in this program is to understand interfacial atomic structure and transformation behavior.

47139 (LBL–26455, pp. 5) **Microstructure, properties, and alloy design: Inorganic materials.** Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This is a multicomponent, interdisciplinary program in advanced inorganic materials involving fundamental quantitative studies of the structure-property relationships in technologically significant materials involved in energy and conservation. All tasks involve characterization of both structure and composition at the highest levels of spatial (transmission electron microscopy) and chemical (spectroscopy) resolutions in order to understand the complexities of structure-chemistry-processing-property relationships, without which alloy design is impossible. Specific tasks include: (a) effect of microalloying on structure properties and processing of duplex martensitic-austenitic composite steels designed for optimum toughness (terminating in 1989); (b) magnetic materials: ceramics, and permanent and hard rare-earth magnets; and (c) high-critical-temperature superconducting ceramics. The overall objectives are to understand structure-property relations so as to design new materials, or to better utilize existing materials and processing routes

for industrial practice and to realize materials and energy conservation.

47140 (LBL–26455, pp. 8-12) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The microstructure, composition, and magnetic properties of $Fe_{14}Nd_2B$ sintered magnets with Dy-Al additions have been characterized using AEM, scanning electron microscopy (SEM), and with a vibrating sample magnetometer (VSM). SEM results reveal that the material has a multiphase microstructure with the matrix having a composition consistent with $Fe_{14}Nd_2B$. Microdiffraction carried out in the AEM confirmed that the matrix phase was indeed tetragonal $Fe_{14}Nd_2B$. The grain-boundary phase was found to be Nd rich and predominantly fcc, with a_0 = 5.2 Å, consistent with a variant of Nd_2O_3, as has been previously reported. It is well known that the substitution of cobalt for iron raises the Curie temperature T_c of the hard magnetic $Nd_2Fe_{14}B$ phase and enhances the thermostability in the temperature range that is important for technical applications. Thus the objective of the experiments was to determine the number, composition, and structure of the grain-boundary phases in melt-spun $Nd_{17}Fe_{77}B_6$ and $Nd_{15}(Fe_{1-x}Co_x)_{77}B_8$ permanent magnets using analytical and high-resolution TEM. In samples without Co, the overall microstructure is similar to that observed by other workers, although very few grain boundaries are laced with an amorphous phase. The grain-boundary phase is crystalline and has an fcc structure with a nominal composition of $Nd_{75}Fe_{25}$, in general agreement with earlier work. For the Co-substituted sample, two other fcc phases have been observed.

47141 (LBL–26455, pp. 13) **Solid-state phase-transformation mechanisms.** Westmacott, K.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This research is directed towards obtaining an atomic-level understanding of the structural factors that govern phase changes and phase stability. Transmission electron microscopy techniques, particularly high-voltage and high-resolution microscopy, are employed to characterize phase changes and to infer the atomic rearrangements occurring during a transformation. By studying alloy systems characterized by strains of different signs and magnitudes, the fundamental mechanisms for a broad range of phase transformations are being identified. It has been possible to predict precipitate morphologies (growth directions, habit planes, orientation relationships, substructure, twinning, etc.) from first principles and to relate them to nucleation and growth processes. Extension of the principles from simple model alloy systems to more complex materials is now in progress.

47142 (LBL–26455, pp. 14) **The coprecipitation of Cr_3P and Cr in Cu.** Witcomb, M.J.; Dahmen, U.; Westmacott, K.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

During TEM studies on Cu-Cr alloys previously considered to be simple binaries, it was found that a minor secondary precipitate phase was also present. Through electron diffraction, EDS, microprobe analyses, and high-resolution imaging, the additional phase was identified as bct Cr_3P and related to the presence of trace amounts of P in the alloys. It was concluded, however, that the phosphide particles precipitate on the primary Cr laths only after they are well-developed. Thus, earlier quantitative analyses of Cr precipitate morphologies in Cu remain valid. Dark-field micrographs illustrating the interesting morphological relationship between the Cr precipitate and the Cr_3P particle are given in Figure 2-1. In (a) and (b) the Cr and Cr_3P are respectively imaged independently, while (c) shows the composite shape when both are imaged simultaneously.

47143 (LBL–26455, pp. 23) **High-resolution electron microscopy (HREM) of interfaces in topotaxial and epitaxial reactions.** Dahmen, U.; Douin, J.; Hetherington, C.J.D.; Westmacott, K.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

In the study of interfaces, HREM is most useful when the interface is viewed edge-on while both crystals are accurately aligned along low-index zone axes. The formation of such interfaces by epitaxy or topotaxy is the natural means of obtaining structures that can be usefully analyzed by HREM. Furthermore, there is intense interest in understanding the atomic structure of such interfaces in a variety of technologically important materials. This contribution addresses such structures produced by thermal decomposition, precipitation reactions, and ionized cluster-beam deposition, and reports on the structural investigation of symmetrical and asymmetrical grain boundaries, precipitate/matrix interfaces, internal defect structure of precipitates, and nanocrystalline composites. A micrograph illustrating the clarity of interface images now attainable with the Atomic Resolution microscope is given in Figure 2-1. The periodic structure along a Σ99 symmetrical grain boundary in an Al bicrystal is resolved at a level where detailed comparison with theory is now possible.

47144 (LBL–26455, pp. 25) **Microstructure of melt-spun Nd-Fe-Co-B magnets.** Koestler, C.; Ramesh, R.; Echer, C.J.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors report results on microstructural characterization of melt-spun $Nd_{17}Fe_{77}B_6$ and $Nd_{15}(Fe_{1-x}Co_x)_{77}B_8$ ribbons using high resolution electron microscopy, x-ray microanalysis, and micro-diffraction. In general, the microstructure consists of the hard magnetic $Nd_2Fe_{14}B$ phase and one or more grain-boundary phases. In all these materials, no $Nd_{1.1}Fe_4B_4$ phase was observed. The grain-boundary phase in the Co-free samples appears mainly at multigrain junctions and is a Nd-rich, crystalline (fcc) phase, whereas the Co-containing specimens comprise two different fcc grain-boundary phases. The structural and microchemical data indicate that these are likely to be ferromagnetic and that they contain significantly less Nd than the grain-boundary phase of the Co-free samples. The average matrix grain diameter is about 80 nm, but there are always some areas in every specimen where the grain diameter is very small (about 20 nm) or very large (more than 300 nm), causing differences in the size of the grain-boundary phases both at the triple grain junctions and between the grains.

47145 (LBL–26455, pp. 26-27) **Critical-voltage estimates of lithium depletion in precipitate-free zones (PFZs) in Al-Li base alloys.** Radmilovic, V.; Fox, A.G.; Fisher, R.M.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Since the effects of PFZs were first examined in high-strength Al-Mg-Zn alloys, much attention has been paid to PFZs and their deleterious effects, especially with respect to the mechanical behavior, fracture, and stress-corrosion cracking, in a wide range of conventional high-strength Al-base alloys, as well as in the newer high-strength Al-Li alloys for aerospace applications. The difficulties of spectroscopic analysis for Li (mainly because of its low atomic number) are well known. An alternative technique for compositional analysis, although indirect, that can be utilized by high-voltage electron microscopy is that of the so-called critical voltage effect, by which it should be possible to measure the percent o Li to within 3%. The 1.5-MeV HVEM with liquid-nitrogen stage available at NCEM is necessary for such analyses. Several alloys based on Al-2% Li with and without 2.5% Cu were studied in the overaged condition. The chemical analyses of alloys A and B indicate that the lithium contents of the center of the grains in both alloys are very nearly the same in both the as-quenched and overaged conditions. This allows a comparison between the critical-voltage measurements made on the two alloys so that possible Li depletion at PFZs can be confirmed. In spite of the unavoidably large errors, the V_c^{222} measurement on alloy B suggest that there is lithium depletion at PFZs.

47146 (LBL–26455, pp. 29) **The preparation of mechanically alloyed powders for TEM examination.** Kamenetzky, E.A.; Wall, M.; Castro, R.; Tanner, L.E. Lawrence Berkeley Lab., CA

(USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

TEM specimens of mechanically alloyed elemental Ni and Nb powders are prepared by a new procedure. The alloyed powders are mixed with smaller Al powders and fill an aluminum ring (3-mm outer diameter). This composite is cold pressed together, with the Al powders taking most of the deformation. The compacted specimen can be mechanically thinned. Electropolishing and ion milling can then proceed by standard methods with special precautions to minimize differential polishing or milling rates. The microstructural aspects of the formation of an amorphous phase by high-energy ball milling of these powders have been studied. After 6 hr each particle transforms to a heterogeneous layered composite of particles of one element in the matrix of the other. Particle size ranges from 15 to 90 nm. Mechanical alloying for 36 hr results in the formation of an apparently uniform phase interspersed with a few small (4-30 nm) elemental crystalline particles. The uniformity of composition and the presence of C, O, and Fe were studied by EDX and EELS.

47147 (LBL–26455, pp. 38) **Local atomic configurations in solid solutions.** de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This investigation is concerned with ordering phenomena in alloys, and the recent emphasis has been on long-period ordered superstructures (modulated structures) in binary fcc alloys. Two systems have been studied in detail: Cu-Pd and Ag-Mg. Structural observations have been carried out using the Atomic Resolution microscope at LBL's National Center for Electron Microscopy (NCEM), and the nature of the periodic antiphase boundaries present in these alloys has been characterized. In addition, a systematic investigation of long- and short-range order in Cu-Pd has been undertaken using in situ variation of temperature and radiation dose in the High Voltage Electron Microscope at NCEM. Other work on the Cu-Pd system, using standard electron microscopy techniques, is directed toward clarification of the equilibrium phase diagram. Concerning the theoretical aspect of this project, a statistical mechanics model for modulated structures in alloys has been proposed and solved within the mean-field approximation. Results show agreement with some real systems. Also, the mechanism governing the distinction between sharp and diffuse antiphase boundaries has been elucidated. New work will focus on the nature of ordered structures in the technologically important Al-Ti system and related ternaries.

47148 (LBL–26455, pp. 38-39) **Concentration waves in Cu-Pd: Fermi surface vs entropy effects.** Kulik, J.; de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Restoration of short-range order (SRO) in Cu-Pd alloys has been observed after samples were initially disordered using the electron beam in a high-voltage (1.5-MeV) electron microscope. Complete disorder under the beam action is observed at 100 K. SRO reappears at temperatures of 150 K and higher due to beam-induced kinetics. Diffuse peaks of SRO scattered intensity appear at positions [1 10] and equivalent in the first Brillouin zone of the disordered fcc lattice. The value of q is known to be dependent on Fermi surface effects, but the authors also observe a weak temperature dependence in the value of q over the temperature range 150 to 400 K. They discuss a possible origin of this phenomenon in terms of entropy effects.

47149 (LBL–26455, pp. 39) **A Gorsky-Bragg-Williams approach to the study of long-period superlattice phases in binary alloys.** Ceder, G.; De Graef, M.; Delaey, L.; Kulik, J.; de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The influence of the shape of the reciprocal-space potential on the relative stability of long-period superlattice (LPS) phases in binary alloys is discussed in a Gorsky-Bragg-Williams approximation. First, for a certain class of LPS phases, the set of pair-interaction parameters is reduced to a similar set of parameters that characterize only the essential aspects of the reciprocal-space potential. Minimization of the free energy for different LPS phases is then used to extract some general tendencies, such as the change of wave vector towards the potential minimum (with increasing temperature) and the increasing stability of complex phases with deepening of the potential minimum.

47150 (LBL–26455, pp. 39) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Portions of the Cu-Pd equilibrium phase diagram are poorly known, particularly in the vicinity of one- and two-dimensional long-period superstructure phase regions. Conventional and high-resolution TEM are currently being used to determine phase boundaries accurately.

47151 (LBL–26455, pp. 40) **Alloy theory.** de Fontaine, D.; Falicov, L.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Temperature-composition phase diagrams are of great practical interest as they constitute useful maps of thermodynamic systems such as binary, ternary..., etc., alloys. These diagrams are generally determined experimentally, but the exciting possibility now exists of deriving certain classes of phase diagrams virtually from first principles. This possibility rests on the very significant advances that have been made recently in the two relevant areas of alloy theory - electronic-band-structure calculations and statistical thermodynamics. The purpose of this project is to combine the latest electronic structure and statistical thermodynamic calculations in integrated packages in order to produce phase diagrams from a minimum amount of empirical information and to compare various approximate computational methods with one another. A temperature-composition diagram for the Ti-Rh system has been derived that agrees remarkably well with the temperature-composition diagram determined empirically. The same theoretical techniques are also being applied successfully to vacancy ordering in the high-T_c superconductors. It has also been proved that for some systems, and probably for many, inclusion of many-body effects beyond the mean-field or density-functional approximations should be taken carefully into account.

47152 (LBL–26455, pp. 40) **A direct method of obtaining effective-pair interactions in binary alloys.** Berera, A.; Dreysse, H.; Wille, L.T.; de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

It is shown that effective-pair interactions (EPI) in disordered binary alloys can be calculated accurately and reliably by direct averaging over a small number of randomly selected configurations within the framework of the recursion method. This approach is illustrated on a canonical tight-binding Hamiltonian and relies on the orbital peeling technique to calculate energy differences directly, without large subtractive cancellations. The results are checked for convergence, as a function of both the number of configurations and the number of levels of the continued fraction, and they are also compared with more elaborate calculations. The main advantages of such a real-space method are the computational simplicity and the possibility to treat deviations from lattice periodicity.

47153 (LBL–26455, pp. 40-41) **Ab initio calculations of ordered intermetallic phase equilibria.** Sluiter, M.; de Fontaine, D.; Guo, X.Q.; Podloucky, R.; Freeman, A.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

General procedures for computing alloy phase equilibria from ab initio electronic structure calculations are reviewed and applied to the Al-Li phase diagram. Free energies were calculated by the cluster variation method in the tetrahedron approximation for the fcc and bcc lattices and ordered superstructures. Input was provided by first-principles FLAPW calculations. The computed phase

diagram for both stable and metastable structures agrees remarkably well with the experimental one.

47154 (LBL–26455, pp. 41) **Phase stability of ternary alloys in the four-sublattice Bragg-Williams approximation.** Chrzan, D.C.; Falicov, L.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A full Bragg-Williams calculation of a four-sublattice face-centered-cubic ternary alloy was carried out. It corresponds to elements that, similarly to Cu, Ag, and Au, form disparate binaries: one pair that strongly segregates, one pair that forms strongly ordered compounds, and a third pair that forms only weakly ordered binaries. The obtained diagrams are internally consistent, have a sensible temperature evolution towards disorder, and present a variety of behaviors that include ordered and disordered homogeneous single phases, and regions of heterogeneous two- and three-phase mixtures. Although not realistic, the calculation gives a good starting point for more sophisticated models that may include short-range correlations and a better thermodynamic treatment.

47155 (LBL–26455, pp. 41) **Many-body small-cluster theory of bcc Fe, Co, and the Fe-CO alloy.** Sowa, E.C.; Falicov, L.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

An exact solution for a two-site crystal model, the smallest body-centered-cubic crystal, was developed for cobalt, iron, and the virtual-crystal iron-cobalt alloy. The model consists of five d-like orbitals per site spin, with interatomic hopping terms and an onsite Coulomb interaction of the fullest generality allowed by atomic symmetry. The ground-state spin polarization per atom is found to begin at 2 for cobalt, rise to 2.5 for the iron-cobalt alloy, and drop back down to 2 for iron. This behavior, which mimics the peak in the Slater-Pauling magnetization curve for this system, is dominated by one-electron properties rather than by the Coulomb interaction. The many-body energy-level spectra and intracluster charge and spin fluctuations are also computed.

47156 (LBL–26455, pp. 44) **High-temperature reactions.** Searcy, A.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The central purposes of this program are to develop and to experimentally test thermodynamic and kinetic models of important processes in materials science. A theoretical breakthrough has been the reconciliation of the kinetics to the thermodynamics of equilibria among edge, surface, and bulk molecules in crystalline particles. The new understanding of the thermodynamics in particles makes it possible to evaluate the previously neglected roles of ledge nucleation and growth in sintering of crystalline particles and in exaggerated grain growth. New expressions for sintering and grain growth are consistent with important experimental observations that are inconsistent with predictions of classical surface thermodynamic theory. A theory for sintering in temperature gradients has been obtained as a consequence of extending the new thermodynamic approach to nonisothermal systems. Tests of various theoretical predictions are in progress.

47157 (LBL–26455, pp. 44) **The influence of temperature gradients on transition temperatures: Predictions from alternate models.** Searcy, A.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Theoretical studies under this project in recent fiscal years demonstrated that equilibrium of crystalline particles with the vapor requires that $\mu_a - \mu_v = \mu_g$, where μ_a, μ_v, and μ_g are the chemical potentials of atoms in the crystal, of vacancies, and of gaseous atoms. This relation indicates that local thermodynamic activities of crystals are sensitive to changes in the local vacancy concentrations. When the relation is introduced into equations for solids placed in a temperature gradient under circumstances that lead to zero net flux exchanges, the prediction emerges that transition temperatures for solids can be changed by measurable amounts. Such a possibility had not previously been suggested.

47158 (LBL–26455, pp. 44) **The influence of temperature gradients on the melting point of tin.** Beruto, D.; Botter, R.; Searcy, A.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Isothermal and nonisothermal steady-state experiments were performed with tin in a graphite crucible equipped with seven thermocouples of carefully determined heights relative to interface positions in imposed temperature gradients. The experiments confirm the predictions of the previous paper that a measurable change in melting temperature could result from a gradient through the solid; the melting temperature decreased 1.7 ± 0.8 K when the temperature drop through the solid tin was 40 K.

47159 (LBL–26455, pp. 85-86) **Quasiparticle excitation spectra of s-p electron metals.** Northrup, J.E.; Surh, M.; Hybertsen, M.S.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The quasiparticle excitation spectrum is calculated for the s-p electron metals Li, Na, K, and Al by evaluation of the electron self-energy operator with use of a first-order expansion in the dressed Green's Function G and the screened Coulomb interaction W. The calculated quasiparticle energies for Na, K, and Al are in excellent agreement with angle-resolved photoemission experiments. For Na and K in particular, the occupied bandwidth is significantly narrower than the free-electron value, as found in experiment. Inclusion of exchange and correlation effects in the dielectric screening matrix is shown to decrease the bandwidth relative to the random-phase approximation (RPA) result by a significant amount. Local-field effects, reflected in the off-diagonal elements of the dielectric matrix, are found to have little effect on the band structure of these simple metals.

47160 (LBL–26455, pp. 89) **Low-temperature properties of materials.** Phillips, N.E. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The objective of this program is to obtain information that contributes to an understanding of the behavior of materials by the measurement of their low-temperature properties, particularly specific heats. There are numerous special cases in which specific-heat data provide either a test of theoretical models or values of important parameters that could not otherwise be obtained. Since much of the work is in the region below 1 K, where the temperature scale is not well established, and because accurate temperature determinations are important for specific-heat measurements, research is also conducted on methods of temperature measurement. An accurate temperature scale that extends to 5 mK has been developed for this region. The interest in high-T_c superconductors has led to an extension of the measurement capabilities to above 100 K. Recent specific-heat measurements include measurements on ^{3}He in the Fermi-liquid region that have established the correct values of important parameters; measurements on a number of heavy-fermion compounds, including three of the four known heavy-fermion superconductors and Th-doped UBe_{13}; and measurements on high-T_c superconductors that have demonstrated the reality of bulk superconductivity and given estimates of the electronic density of states. Future objectives include additional studies on high-T_c superconductors, and specific-heat measurements at pressures to 20 kbar and in magnetic fields to 9 T on other heavy-fermion compounds.

47161 (LBL–26455, pp. 89-90) **Specific heat of UPt_3: Evidence for unconventional superconductivity.** Taillefer, L. (CRTBT/CNRS, Grenoble (France)); Hasselbach, K.; Flouquet, J.; Giorgi, A.L.; Smith, J.L.; Fisher, R.A.; Kim, S.; Woodfield, B.F.; Phillips, N.E. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Two new samples of UPt_3 that show sharper superconducting transitions than any observed in the past have shown a distinct splitting of the specific-heat anomaly at the zero-field transition into

two components separated by 60 mK. From several lines of evidence, it has been concluded that the splitting is an intrinsic property of the superconductivity of UPt_3 and shows that the pairing cannot be purely s-wave. This result constitutes a relatively direct indication that the superconductivity of UPt_3 differs from that of conventional BCS superconductors. The parameters characterizing the superconducting state specific heat have been correlated with those for a variety of other UPt_3 samples on the basis of a model in which a linear term in the specific heat and a finite density of states at the Fermi energy are produced by a pair-breaking mechanism, and the superconductivity is associated only with the remainder of the normal-state density of states. The correlation is internally consistent and gives values of the parameters for the fully superconducting material. In the vicinity of 5K, where μSR and neutron-scattering measurements show a very weak magnetic ordering, there is no effect, to within an accuracy of $\sim$ 0.1T, in the specific heat. This is a further indication that the magnetic ordering is extremely weak.

47162 (LBL–26455, pp. 90) **Pressure dependence of the specific heat of heavy-fermion compounds.** Flouquet, J. (CRTBT/CNRS, Grenoble (France)); Amato, A.; Jaccard, D.; Fisk, Z.; Georgi, A.L.; Smith, J.L.; Stewart, G.R.; Phillips, N.E.; Fisher, R.A.; Lacy, S.E.; Marcenat, C.; Olsen, J.A. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The specific heats of $U_{0.97}Th_{0.03}Be_{13}$ and URu_2Si_2 have been measured under pressures to 9 kbar at temperatures between 0.4 and 25 K. Each of these materials shows both superconducting and antiferromagnetic ordering temperatures, and related parameters can contribute to an understanding of the relation between superconductivity and magnetism. In the case of $U_{0.97}Th_{0.03}Be_{13}$ at zero pressure, the superconducting transition occurs near 0.6 K, and there is a second specific-heat anomaly near 0.4 K. Under pressure, both ordering temperatures are lowered, and the entropy associated with the second is rapidly reduced with increasing pressure. The qualitative difference between the two pressure dependencies suggests that the two specific-heat anomalies are different in origin, consistent with μSR data that show weak magnetic ordering associated with the second. In the case of URu_2Si_2, there is a transition to an antiferromagnetic state, which involves moments of the order of a Bohr magnetron, at 17 K, and a superconducting transition, in the antiferromagnetic state, near 1.4 K. Both transitions are pressure dependent, but analysis of the results is not complete.

47163 (LBL–26455, pp. 91) **Specific-heat data of high-T_c superconductors: Lattice and electronic contributions.** Gordon, J.E.; Tan, M.L.; Fisher, R.A.; Phillips, N.E. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

An analysis of high-temperature data for YBCO, in which the lattice specific heat is represented by an expansion in inverse powers of T, has been used to estimate γ (the normal-state value). The interesting result is that the value agrees approximately with those estimated from the jump in C at T_c (using BCS relations) and that obtained from γ(H) in the mixed state.

47164 (LBL–26455, pp. 94) **High-temperature thermodynamics.** Brewer, L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The understanding of high-temperature chemistry is not only important for processes carried out at high temperature such as those of fusion and fission reactors and fossil-fuel power generators, but it is also important for the preparation and fabrication of ceramics, metals, semiconductors, superconductors, and many other materials. The understanding of high-temperature behavior is complicated by the occurrence of unusual species and phases that are often unstable at conventional temperatures. It is difficult to carry out measurements to obtain the data needed for the design of high-temperature systems. The experiments in progress are aimed at the testing or development of such predictive models. Previous research of this program has led to the development of a variety of successful models of predictive capability for the behavior of gases, refractory containment materials, and of many metallic systems. At the present time the main thrust of the research is aimed at providing quantitative predictive models for the strongly interacting transition-metal alloys exhibiting generalized Lewis acid-base behavior. A variety of experimental methods are being used to characterize the thermodynamics of these systems.

47165 (LBL–26455, pp. 95-96) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Additional data on the strength of generalized Lewis acid-base interactions is being obtained using high-temperature EMF cell measurements and ternary phase equilibria. These data are being combined with data from the literature to develop a model for characterizing these acid-base interactions for aids of the third to fifth groups, including the lanthanides and actinides and bases of the Ni-Pd, Co-Ir, and Fe-Os groups. Models are also being developed using data from the literature for interactions of the platinum metals, acting as acids, with nontransition metals such as Zn, Ga, and Si acting as bases.

47166 (LBL–26455, pp. 99) **The kinetics of tungsten etching by atomic and molecular chlorine.** Balooch, M.; Fischl, D.S.; Olander, D.R.; Siekhaus, W.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The reactions of atomic and molecular chlorine with tungsten were studied by modulated-beam mass-spectrometric methods over the temperature range 300-1,350 K. The atomic beam was generated by an RF plasma discharge. With both atomic and molecular beams, the main reaction product up to about 1,000 K was WCl_4. The reaction probability with atomic chlorine was a factor of approximately ten higher than that obtained with molecular chlorine. The reaction was nonlinear with respect to Cl_2 intensity at low beam fluxes but approached linearity at high beam intensities. Above 1,000 K the main reaction product was atomic chlorine. Its reaction probability increased rapidly with temperature; at 1,300 K nearly complete dissociation of Cl_2 was observed. A kinetic model based on the Eley-Rideal mechanism was proposed and compared with the data.

47167 (LBL–26455, pp. 99-100) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The reaction of chlorine with refractory metals is being investigated by th molecular-beam method. The amorphization of intermetallic precipitates in Zircaloy is being studied by irradiation by high-energy electrons. The high-temperature corrosion of Zircaloy by steam in the presence of hydrogen is being studied by a gravimetric technique. The solubility of hydrogen in Zircaloy is also being investigated. Oxygen self-diffusion in the tetragonal high-temperature form of zirconia is being measured gravimetrically using the oxygen-isotope exchange method. The interaction of iodine vapor with oxidized steel is being studied in a flow system with mass-spectrometric sampling. The effect of grain size of UO_2 on the release of fission products is being investigated. A simple mathematical technique for incorporating the heat effect of a phase change on moving-boundary heat-conduction problems is under investigation. The combined effects of moving grain boundaries and solute diffusion into the lattice on solute transport by grain-boundary diffusion are being analyzed theoretically.

47168 (LBL–26455, pp. 101) **STM observations of the electrodeposition of copper.** Armstrong, M.J.; Muller, R.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Scanning tunneling microscopy (STM) has been used to investigate the electrocrystallization of metals with atomic resolution of surface topography. Parasitic currents to the Pt tunneling probe have been reduced to 10% of the tunneling current by the application of insulating coatings of polyvinylidine fluoride to the probe and

by floating operation of electronic components. In order to avoid Faradaic currents between probe and surface, the probe potential was restricted to the range between Cu deposition and Pt oxidation. Software has been developed to digitally collect data in an array of 320 by 200 points and to display results in different forms: derivative-coded intensity has been found particularly effective to represent topographies. Cu deposition on Pt(111) from 5mM $Cu(ClO_4)_2$, 0.5M $NaClO_4$ was followed by STM in a constant-tunneling-current (2nA) mode with a sample-to-probe bias of −100 mV. Deposition rates under potential control were found to be highly nonuniform on a submicroscopic scale. The rate of deposit growth (at 50 mV), was ~ 1,000 Å/min in areas where nucleation had occurred. Single and multiatomic steps between smooth regions in the deposit were found to be stable under cathodic potential control, but they disappeared at open circuit. These observations illustrate changes that may occur during transfer of electrochemical specimens form the liquid phase.

47169 (LBL–26455, pp. 103-104) **Enhancement of mass transfer by suspended solids.** Andersen, P.K.; Muller, R.H.; Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Concentrated suspensions of inert solids have been found to increase mass transfer to a rotating disk by as much as fourfold. Enhancement increases with shear rate and is greatest for particles of size comparable to the thickness of the mass-transfer boundary layer. For small particles, a mechanism that involves microconvective vortices, which increase the dispersion of solutes and the dissipation of energy, is proposed. For particles much larger than the thickness of the mass-transfer boundary layer, transport enhancement is proposed to result from the formation of a particle-depleted slip layer at the electrode surface. The increased shear rate in this layer compared to that in a homogeneous suspension results in a thinning of the mass-transfer boundary layer.

47170 (LBL–26455, pp. 107) **Clusters in solids.** Caplan, D.; Chmelka, B.; Koenig, M.; Pearson, J.; Raftery, D.; Schmidt, C. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Two techniques are being further developed and used to count clusters and to characterize the distribution of atoms and molecules in solids. The first technique is multiple-quantum NMR, which involves the selective detection of spectroscopic events in which groups of n spins flip and groups of n radiofrequency quanta are absorbed or emitted. The second technique is xenon NMR, in which the spherical xenon atom is used as a sensitive probe of its surroundings. Problems being studied by these techniques include the distribution of molecules and metal particles in zeolite cavities, the dynamics of dilute spin systems, and molecules intercalated in graphite.

47171 (PNL-SA–17621) **Irradiation-induced microchemical effects and IASCC initiation.** Simonen, E.P.; Charlot, L.A.; Bruemmer, S.M. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900623–16: 15. symposium on effects of radiation on materials, Nashville, TN (USA), 17-21 Jun 1990). Order Number DE90016565. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Predicted irradiation-induced enrichment of silicon and depletion of chromium at grain boundaries were consistent with measurements of ion irradiated stainless steel grain boundary microchemistries. The calibrated solute drag mechanism for silicon enrichment and the inverse-Kirkendall mechanism for chromium depletion were then used to predict behaviors for neutron irradiation conditions relevant to irradiation-assisted stress corrosion cracking. A simple crack chemistry model illustrated how irradiation-induced chromium depletion might affect intergranular corrosion as a function of dose. 23 refs., 11 figs.

47172 (PNL-SA–17825) **Strength and toughness of single-phase and dual-phase high- temperature intermetallics.** Bruemmer, S.M.; Brimhall, J.L.; Henager, C.H. Jr. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 7p. Sponsored by U.S. Department of Defense; U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900466–82: Spring meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Order Number DE90017192. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The strength and toughness of several high-temperature beryllium- niobium ($Be_{12}Nb$ and $Be_{17}Nb_2$) and iridium-niobium (Ir_3Nb) intermetallic compounds have been evaluate. Materials were prepared by high-rate sputter deposition and characterized by x-ray diffraction and analytical electron microscopy before and after heat treatment. As-sputtered microstructures were varied from amorphous to microcrystalline by control of substrate temperature. Grain size, degree of order, and second-phase distribution were modified by subsequent heat treatment. Strength as a function of temperature was assessed by hot hardness tests and toughness estimated from indentation-induced crack lengths. Intermetallics exhibited very high strength and low toughness up to temperatures of ~1000 C. Mechanical behavior was a direct function of the microstructural parameters including matrix phase composition, second phase distribution, and degree of order. 5 refs., 3 figs.

47173 (UCRL-JC–103469) **High strain rate deformation behavior of shocked copper.** Lassila, D.H. (Lawrence Livermore National Lab., CA (USA)); LeBlanc, M.; Gray, G.T. III. Lawrence Livermore National Lab., CA (USA). Aug 1990. 9p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-900818–3: International conference on shock wave and high-strain-rate phenomena in materials, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016481. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Uniaxial mechanical testing of shock-prestrained copper was performed over a range of strain rates from 10E-3 to 7x10E3 s-1 in tension and compression to study the effects of shock-induced substructure on constitutive behavior. For comparison, copper in the preshocked condition (annealed, 15um grain size) was also tested. Results of the study show that the post shock mechanical behavior of copper at high strain rates is similar to that previously reported at slow strain rates, i.e. the shocked copper had an increase in yield strength and a decrease in work hardening rate. The strain rate sensitivity of the shocked copper was found to be similar to that of the unshocked material. Tensile test results fro both high and low strain rate tests are presented and show the elongation of the shocked material to be considerably less than that of the unshocked material. The effects of the constitutive behavior of the shocked and unshocked materials on elongation are discussed.

47174 (VTT-TIED–1113) **The effect of offshore structural steel permeability on underwater magnetic particle inspection.** Pitkaenen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Aastroem, T. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1990. 36p. (In Finnish). Order Number DE90518736. Source: NTIS (US Sales Only), PC A03/MF A01.

For underwater applications the most frequently used non-destructive testing (NDT) methods are visual and magnetic particle testing. Magnetic particle testing is used mainly due to the fact that its ability to indicate discontinuities under water is just about as good as its ability in air. The report deals with background factors influencing the flaw detectability in magnetic particle testing with special emphasis on manipulator-operated underwater testing. A prerequisite for a reliable testing is a properly performed calibration. The most important factor as far as the calibration is concerned is the selection of the magnetic field strength to be used. The selection is primarily affected by the permeability of the material to be tested. The paper discusses the permeabilities of typical offshore structural steels and the factors affecting them.

47175 A novel procedure to study crack initiation and growth in thermal fatigue testing. Marchand, N.J.; Dorner, W.; Ilschner, B. pp. 237-259 of Surface-crack growth: Models, experiments, and structures; Proceedings of the Symposium, Sparks, NV, Apr. 25, 1988. Reuter, W.G.; Underwood, J.H.; Newman, J.C. Jr. American Society for Testing and Materials, Philadelphia, PA (US) (1990). (CONF-8804331–: Surface-crack growth: models, experiments, and structures symposium, Sparks, NV (USA), 25 Apr 1988).

An induction heating procedure coupled with an advanced alternating-current potential drop (ACPD) system to study thermal fatigue crack initiation and growth is presented. Details of the experimental apparatus and the ACPD system are given. To illustrate the procedure, the effect of three cyclic thermal histories on the number of cycles to crack initiation of double-edge wedge specimens of IN-100 and MA-6000 superalloys was studied in air. The thermoelastoplastic finite-element analyses (FEA) to determine the critical locations and their respective stress-strain histories are presented. For this particular geometry of specimen, the initiation of microcracks about 10 to 20 microns in length could be detected, and crack growth rates lower than 1 micron/cycle were measured. The experimental results combined with the FEA showed that the peak compressive strains encountered on specimen heat-up are more critical to crack initiation and surface degradation than total stress or strain ranges. 31 refs.

47176 The structural phase transition in the RECu6 compounds (RE = La, Ce, Pr, Nd). Vrtis, M.L. (Northwestern Univ., Evanston, IL (USA)); Jorgensen, J.D.; Hinks, D.G. *Journal of Solid State Chemistry (USA)*, 84(1): 93-101 (Jan 1990). DOE Contract W-31-109-ENG-38.

The structure of the $RECu_6$ compounds (where RE = La, Ce, Pr and Nd) has been studied using time-of-flight neutron powder diffraction at temperatures ranging from 10 to 573 K. The compounds exhibit a temperature-dependent distortion of the high-temperature orthorhombic cell to a monoclinic one with transition temperatures between 151 and 455 K depending on the rare earth ion. The space groups and the temperature dependence of the monoclinic strain are consistent with a second-order transition driven by a soft acoustic phonon mode. Since the lanthanum compound with no 4f electron also exhibits the same transition, it is unlikely that electronic effects involving the 4f shell are responsible for the transition observed in these materials.

47177 Formation of amorphous metal alloys by chemical vapor deposition. Mullendore, A.W. To Dept. of Energy, Washington, DC (USA). USA Patent 4,929,468/A/. 29 May 1990. Filed date 18 Mar 1988. USA Patent Application 7-170,228. Int. Cl. B05D 3/14. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes amorphous alloys deposited by a process of thermal dissociation of mixtures or organometallic compounds and metalloid hydrides, e.g., transition metal carbonyl such as nickel carbonyl, and diborane. Various sizes and shapes of deposits can be achieved, including near-net-shape free standing articles, multilayer deposits, and the like. Manipulation or absence of a magnetic field affects the nature and the structure of the deposit.

47178 Method and apparatus for atomization and spraying of molten metals. Hobson, D.O.; Alexeff, I.; Sikka, V.K. To United States Dept. of Energy, Washington, DC (USA). USA Patent 4,919,335/A/. 24 Apr 1990. Filed date 19 Jul 1988. USA Patent Application 7-221,393. Int. Cl. B05B 5/06. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method and device for dispersing molten metal into fine particulate spray. It comprises applying an electric current through the molten metal and simultaneously applying a magnetic field to the molten metal in a plane perpendicular to the electric current, whereby the molten metal is caused to form into droplets at an angle perpendicular to both the electric current and the magnetic field. The device comprises a structure for providing a molten metal, appropriately arranged electrodes for applying an electric current through the molten metal, and a magnet for providing a magnetic field in a plane perpendicular to the electric current.

47179 High temperature creep resistant austenitic alloy. Maziasz, P.J.; Swindeman, R.W.; Goodwin, G.M. To Dept. of Energy, Washington, DC (USA). USA Patent 4,849,169/A/. 18 Jul 1989. Filed date 13 May 1988. USA Patent Application 7-193,705. Int. Cl. C22C 30/00. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an improved austenitic alloy having in wt % 19-21 Cr, 30-35 Ni, 1.5-2.5 Mn, 2-3 Mo, 0.1-0.4 Si, 0.3-0.5 x, 0.1-0.3 Nb, 0.1-0.5 V, 0.001-0.005 P, 0.08-0.12 C, 0.01-0.03 N, 0.005-0.01 B and the balance iron. It is further improved by annealing for up to 1 hour at 1150° -1200°C. and then cold deforming 5-15 %. The alloy exhibits dramatically improved creep rupture resistance and ductility at 700°C.

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Refer also to citation(s) 46881, 46902, 46958, 47130, 47133, 47138, 47139, 47151, 47156, 47157, 47160, 47163, 47260, 47284, 47295, 47299, 47302, 47305, 47306, 47307, 47308, 47311, 47358, 47364, 47365, 47369, 47381, 47382, 47399, 47460, 47467, 47934, 47935, 47943, 47944, 47945, 47946, 48037, 48038, 48048

47180 (AD-A-222027/5/XAB) **Micromechanics of interfaces in high-temperature ceramics. Annual report No. 1, FY89-FY90.** Mura, T.; Brittain, J.O.; Faber, K. Northwestern Univ., Evanston, IL (USA). Center for Quality Engineering and Failure Prevention. 28 Feb 1990. 58p. Grant AFOSR-89-0269. (NU-CENTER-QEFP-0650-350-R402). Source: NTIS, PC A04/MF A01.

Results of the initial phase of a program to investigate the micromechanics of interfaces are summarized. Model experiments have been devised and implemented to follow crack propagation in a fiber reinforced transparent matrix by visual observations and electrical resistance of the fiber. In addition, pull-out test on the same composites have been carried out with several matrix-fiber interface modifications. Some success has been achieved in separating debonding and frictional components at the interface. We also report on the very early stage of experiments that have been initiated to study the in-situ debonding behavior during pull-out in a ceramic composite by utilizing a photo-elastic technique.

47181 (AD-A-222373/3/XAB) **Identification of tetragonal and cubic structures of zirconia. Technical report, June 1989-May 1990.** Srinivasan, R.; De Angelis, R.J.; Ice, G.; Simpson, S.F.; Harris, J.M. Utah Univ., Salt Lake City, UT (USA). Dept. of Chemistry. 29 May 1990. 37p. Contract N00014-89-J-1412. (TR-20-ONR). Source: NTIS, PC A03/MF A01.

X-ray diffraction from a synchrotron source was employed in an attempt to identify definitively the crystal structures in zirconia ceramics produced by sol-gel method. The particles of chemically precipitated zirconia, after calcination below 600 C, are very fine, and have a diffracting particle size in the range of 7-15 nm. Since the tetragonal and cubic structures of zirconia have very similar lattice parameters, it is difficult to distinguish between the two. The tetragonal structure can be identified only by the characteristic splittings of the Bragg profiles from the c index planes. However, these split Bragg peaks from the tetragonal phase in zirconia overlap with one another due to particle size broadening. In order to distinguish between the tetragonal and cubic structures of zirconia, three samples were studied using synchrotron radiation.

47182 (AD-A-222489/7/XAB) **Self-lubricating surfaces by ion-beam processing. Final report, 11 August 1989-16 March 1990.** Bhattacharya, R.S. Universal Energy Systems, Inc., Dayton, OH (USA). Jun 1990. 34p. Contract F33615-89-C-2944. Source: NTIS, PC A03/MF A01.

The primary research objective of this work was to develop self-lubricating surface and coatings through direct ion implantations and a combined process of electron beam evaporation and ion implantation. The latter is most commonly referred in the literature as ion beam assisted deposition (IBAD). IBAD of bi-layer coating of (Calcium Fluoride/Silver) on (Silicon nitride) resulted in a very adherent coating that exhibited significantly low friction and wear characteristic at both room and elevated temperatures (800 deg C). Ion beam assisted titanium dioxide coating on M50 steel showed significantly improved friction and wear characteristics at room temperature. Ion beam assisted Cadmium Oxide coating lowered the friction coefficient of M50 steel 400C. The ion beam assisted deposition technique for fabricating self-lubricating surfaces appears to have good technical feasibility for defense and industrial applications, owing to the overall simplicity and scalability of the technique. The initial applications are likely to be in the seals and bearings of engines, variable stator vanes, etc., in gas turbine engine technology.

47183 (AD-A-222553/0/XAB) **Preparation and properties of uniform mixed and coated colloidal particles. Part 5. Zirconium compounds.** Aiken, B.; Hsu, W.P.; Matijevic, E. Clarkson Univ., Potsdam, NY (USA). Dept. of Chemistry. 1990. 12p. Contract F49620-85-C-0142. Source: NTIS, PC A03/MF A01.

Pub. in Jnl. of Materials Science, Vol. 25, 1886-1894(1990). See also Part 6, AD-A216 164.

Colloidal dispersions of uniform spherical particles by zirconium basic sulphate and zirconium oxy-basic carbonate were prepared by ageing zirconium sulphate solutions at elevated temperatures in the presence of urea. Different chemical compositions of the above products resulted when the ageing temperature was altered. Depending on the nature of the original solids, calcination at 800 C resulted in the formation of tetragonal or monoclinic zirconia. Under certain conditions a mixed phase, including cubic zirconia, has also been identified. The particle morphology was retained during these transformations. Coprecipitation in mixed solutions of zirconium and yttrium salts aged at 80 C yielded composite spherical particles of basic carbonate with a zirconium to yttrium ratio of the solid similar to that used in the initial solution.

47184 (DOE/PC/79921–T8) **Pore structure and reactivity changes in hot coal gas desulfurization sorbents: Technical progress report for the period April–June 1990.** Sotirchos, S.V. Rochester Univ., NY (USA). Dept. of Chemical Engineering. Jul 1990. 20p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79921. Order Number DE90016764. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The primary objective of the project is the investigation of the structural and reactivity changes occurring in metal/metal oxide sorbents used for desulfurization of hot coal gas during sulfidation and regeneration, with particular emphasis placed on the effects of these changes on the sorptive capacity and efficiency of the sorbents. This quarter, pore structure characterization and reactivity evolution experiments were carried out using a zinc oxide sorbent (United Catalysts C7-2) that has higher porosity and larger average pore size than the United Catalysts G-72D sorbent employed thus far in our experiments. Like in the case of the G-72D sorbent, experiments have been carried out for various particle sizes, obtained by crushing the cylindrical extrusions supplied by United Catalysts and sieving the fragments. Detailed mathematical models for transport, reaction, and structure evolution in chemically reacting porous media, described in past reports, were used to analyze the obtained reactivity data for the C7-2 sorbent. Excellent quantitative agreement between experimental data and model predictions was observed. During this period, we also carried out measurements of effective diffusion coefficients in fresh and partially reacted sorbents (G-72D and C7-2). Some of these results will be presented and discussed in our next quarterly report. 10 refs., 8 figs.

47185 (IS-M–622) **Upper critical field of grain oriented cuprate superconductors.** Finnemore, D.K.; Hyun, O.B.; Athreya, K.; Lichtenberger, K.S.; Demento, M. Ames Lab., IA (USA). [1988]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. (CONF-880207–8: Discussion meeting on high-$T_c$superconductors, Mauterndorf (Austria), 7-11 Feb 1988). Order Number DE90016703. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In a preliminary study of grain aligned $Y_1Ba_2Cu_3O_7$ having a grain size ranging from 2 to 4 μm, it was found that H_{c2}=30(1-T/T_c)$^{1/2}$ tesla where T_c=91.8 K. For this sample, the grains behaved like a stack of thin films. In the Budzin et al. model for twin plane enhancement, there are two transition temperatures, $T_c$for the twin planes and T_{co} for the bulk. Analyzing the data in these terms gives T_c=91.8 K and T_{co}=90.0 K for a coherence distance in the a-b plane ξ_{oab}=1.5 nm. The purpose of the work reported here is to see how general this result is by reporting data for $Ho_1Ba_2Cu_3O_7$ grain aligned samples and data for one single crystal. 5 refs., 3 figs.

47186 (IS-M–624) **Resistivity peaks and nonmetal-metal transitions in hydrides of La and Ce.** Shinar, J.; Dehner, B.; Beaudry, B.J. Ames Lab., IA (USA). [1988]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. (CONF-880969–7: International symposium on metal-hydrogen systems, fundamentals and applications, Stuttgart (Germany, F.R.), 4-9 Sep 1988). Order Number DE90017416. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The normalized resistivity $\rho_n(T) = \rho(T)/\rho(295K)$ of LaH_x and CeH_x, $2.70 \leq x \leq 2.93$, was measured by an indirect Q-factor technique at frequencies $4 \leq \nu \leq 44$ MHz and temperatures $120 \leq T \leq 500$ K. In LaH_x, $\rho_n(T)$ peaks at some temperature $220 \leq T \leq 260$ K for all $2.70 \leq x \leq 2.90$. The peak becomes sharper with increasing x, and appears critical-like for x=2.88 and 2.90. In $LaH_{2.93}$, the peak is reduced to a kink and ρ_n displays semiconducting-like behavior for all T<300 K. The peak in $CeH_{2.78}$ is relatively "flat" from 238–227 K; in $CeH_{2.82}$ it broadens to a plateau from ~233–175 K, before decreasing at lower temperatures. At higher concentrations, the behavior is semiconducting-like at all x. It is suggested that the observed complex behavior in both LaH_x and CeH_x is due to the distinct structural transitions of the metal and H sublattices, and /or lattice constant anomalies. In some cases, the transition involves a high T, semiconducting cubic phase and a low T, weakly metallic one, of comparable σ. Possible sources of this unusual transition are discussed. 16 refs., 3 figs.

47187 (IS-M–626) **Measurement and correlation of optical and TEM [Transmission Electron Microscopy] twins in $Y_1Ba_2Cu_3O_{7-\delta}$.** Chumbley, L.S.; Verhoeven, J.D.; Kim, M.R.; Cornelius, A.L.; Kramer, M.J. Ames Lab., IA (USA). [1988]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. (CONF-880812–47: Applied superconductivity conference, San Francisco, CA (USA), 21-25 Aug 1988). Order Number DE90016705. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The spacing of the twins present in $Y_1Ba_2Cu_3O_{7-\delta}$ has been investigated using optical and Transmission Electron Microscopy (TEM). Studies have reported that the value of the average twin spacing obtained by optical measurements is much larger than that measured in thin foils prepared for TEM observation, and controversy exists as to the exact nature of the optical twins. Experiments have been conducted which show that the twins observed optically correspond to those seen using TEM and are not produced by an optical interference effect. Using electron channeling, equations have been formulated which allow optical determination of the true spacing of twins present in a selected grain as well as the orientation of that grain. The average twin spacing measured in TEM has been found to vary with sample preparation method, being smaller for crushed chip samples that for bulk samples prepared by ion milling or jet-polishing. A variation of the twin spacing with grain size has also been noted. 12 refs., 6 figs., 2 tabs.

47188 (KFK–4701) **Assessment of the physico-chemical properties of phases in the Na-U-Pu-O system.** Kleykamp, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheit. May 1990. 31p. Order Number DE90519891. Source: NTIS (US Sales Only), PC A03/MF A01.

A critical review is given on the physico-chemical properties of phases in the Na-O, Na-U-O, Na-Pu-O and Na-U-Pu-O systems. This includes the phase diagrams as well as the crystallographic, mechanical, thermal, thermodynamic, transport, optical and chemical properties. This data is to be used for the modelling of the thermal, mechanical and chemical behaviour of defective LMFBR mixed oxide pins during and after reactor operation. (orig.).

47189 (KFK–4724) **Thermal shock behaviour of ceramic materials used in nuclear fission and fusion technology.** Zimmermann, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion. May 1990. 44p. (In German). Order Number DE90519892. Source: NTIS (US Sales Only), PC A03/MF A01.

The thermal shock behaviour of various ceramics used in nuclear fission reactors and provided for application in fusion reactors were investigated. The thermal shock tests were carried out by dipping pellets into a bath of liquid metal, usually tin. The heating up test from room temperature was the preferred test method. The measured critical temperature differences are compared with the thermal shock resistance parameter R and are used to calculate

the stresses in the pellets. Generally there is a reasonable agreement between the calculated maximum tensile stress and the ultimate bending strength, especially for oxides. (orig.).

47190 (KU-HCOE-FL2-R-90-7) **Compression of ThC to 50 GPa.** Gerward, L. (Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. of Applied Physics); Staun Olsen, J.; Benedict, U.; Luo, H. Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1990. 12p. Order Number DE90639536. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Thorium monocarbide crystallizes in the NaCl type structure (space group Fmanti 3m) at room temperature and atmospheric pressure. Very little has been published on the structural high-pressure behaviour of this compound. In a previous study ThC was compressed to 36 GPa and the bulk modulus B_0 was determined. No phase transformation was observed in contrast to the case of the corresponding uranium compound UC, which transforms to an orthorhombic structure at about 27 GPa. It has been suggested that the B_0 value might be too low, considering the bulk modulus scaling with specific volume for thorium and uranium compounds. Thus it should be useful to confirm the B_0 value for ThC and to look for structural phase transformations in an extended pressure range. (orig.).

47191 (KU-HCOE-FL2-R-90-8) **A study of the structural stability of TiC, TiN and TiO in the pressure range up to 65 GPa using synchrotron radiation.** Noerlund Christensen, A. (Aarhus Univ. (Denmark). Dept. of Inorganic Chemistry); Gerward, L.; Staun Olsen, J.; Steenstrup, S. Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1990. 13p. (CONF-9001110--: 13. Nordic meeting on structural chemistry, Copenhagen (Denmark), 8 Jan 1990). Order Number DE90639537. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Structural phase transformations in TiC, TiN and TiO could possibly occur at high pressure because of the non-stoichiometric nature of these compounds. The NaCl structure could then possibly transform to the CsCl structure, in which case the coordination number would increase from six to eight. This is in agreement with the general rule that the coordination number increases with pressure. The present work was undertaken in order to investigate possible structural phase transformations in TiC, TiN and TiO in the pressure range up to 65 GPa (=650 kbar). (orig.).

47192 (LA-UR-90-2699) **High-strain-rate compression and fracture of B_4C-aluminum cermets.** Blumenthal, W.R. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-9008125--5: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016568. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The compressive behavior of liquid-metal infiltrated boron carbide-aluminum cermets were studied as a function of strain rate, composition, and microstructure. Hopkinson split pressure bar (HSPB) and quasi-static compression tests were conducted using dumb-bell-shaped specimens. Results showed cermet compressive strength to be independent of loading rate. Strength was also found to be independent of the aluminum alloy used to infiltrate pre-sintered 65 vol % B_4C pre-forms. compositions with the smallest phase size displayed the best strength and ductility. 18 refs., 4 figs.

47193 (LA-UR-90-2792) **Electronic, structural and transport properties of (almost) rare-earth-like actinide hydrides.** Ward, J.W. (Los Alamos National Lab., NM (USA)); Cort, B.; Goldstone, J.A.; Lawson, A.C.; Cox, L.E.; Haire, R.G. Los Alamos National Lab., NM (USA). [1990]. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900802--5: 200. American Chemical Society national meeting, Washington, DC (USA), 26-31 Aug 1990). Order Number DE90016491. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

By the virtue of broad-band, hybridized 5f-electron behavior, the hydride systems for Pa and U exhibit unique properties and structures, the actinide metal atoms existing in different states. A sudden change at Np to more rare-earth-like behavior implies a major change in electronic structure. There are both many parallels but also enigmas for the Np + H and Pu + H systems. Electrical resistivities are large and complex with temperature. Low-temperature structural transitions as studied by neutron diffraction help elucidate some of these effects. Phonon spectra are quite rare-earth-like, and XPS data imply a metal atom with mostly d-screened core levels. Then it is at americium, where fully localized and corelike 5f electrons are found, that we look finally for true rare-earth-like behavior, which should include a large drop in electrical resistivity. 33 refs., 7 figs., 1 tab.

47194 (LA-UR-90-2799) **Calculation of the static magnetism of metamagnetic La_2CuO_4.** Coffey, D. Los Alamos National Lab., NM (USA). [1990]. 13p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-901004--1: Conference on magnetism and magnetic materials, San Diego, CA (USA), 30 Oct - 2 nov 1990). Order Number DE90016490. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Interactions in La_2CuO_4 are predominantly antiferromagnetic. However a strong field induced transition is seen in the static magnetic susceptibility which points to the existence of a net ferromagnetic moment in the CuO layers. Here, this net ferromagnetic moment is incorporated into a description of the CuO layers by the inclusion of a modified Dzyaloshinskii-Moriya term in the Hamiltonian. The spin wave spectrum in the presence of an applied field is calculated with this Hamiltonian and the ground state is determined as a function of applied field from the free energy. A calculation of the static magnetization as a function applied field perpendicular to the CuO layers is used to determine the parameters of the model. Comparison is made with experiment. 10 refs., 1 fig.

47195 (LA-UR-90-2847) **Superconducting borides.** Fisk, Z. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-900870--3: 10. international symposium on boron, borides and related compounds, Albuquerque, NM (USA), 27-30 Aug 1990). Order Number DE90016484. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A number of superconductors are found among binary and ternary boride compounds. The highest T_c's are often fund near a limiting composition for the compound's stability. Ternary borides have been a fertile area for exploring the interaction between superconductivity and magnetism, and appear to be the area in which further aspects of boride superconductivity will be pursued. 25 refs., 3 tabs.

47196 (LBL-26455, pp. 1) **Grain boundaries in YBCO oxide superconductors.** Zandbergen, H.W.; Hetherington, C.J.D.; Thomas, G.; Gronsky, R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

It is now well established that grain boundaries are the most problematic microstructural constituents in the new oxide superconductors, particularly with respect to their ability to carry high critical currents. The problem stems from the severely anisotropic nature of the orthorhombic crystal structure in YBCO ($YBa_2Cu_3O_{7-\delta}$), necessitating connectivity of the CuO planes for conduction of the super-current. This study has given attention to the atomic structure of grain boundaries, mapping out atomic positions in the boundary vicinity by direct imaging in the Atomic Resolution Microscope (ARM) and other microscopes, and verification of atomic models through computer simulation and processing. During the past year, it has been found that (1) very few boundaries in properly fabricated materials have amorphous, insulating grain-boundary phases of the type that occur in fluxed, sintered ceramics; (2) many grain boundaries have a contiguous atomic structure that is an abruptly terminated variation of normal stacking, leading to possible insulating layers of a crystalline variety; (3) double CuO layer defects nucleate at grain boundaries in the same manner as free surfaces, leading to bifurcation of conduction planes at grain junctions; (4) the high frequency of occurrence of (001) grain-boundary planes is associated with precursor 90° rotation twins in the tetragonal phase of YBCO; and (5) specimen-preparation procedures for electron microscopy of grain boundaries in these materials must include precautions that guard against the formation of intercalation defects, particularly the double CuO plane variety.

47197 (LBL–26455, pp. 2) **On the structure of $(CuO)_2$ double layers in superconducting $YBa_2Cu_3O_{7-\delta}$.** Zandbergen, H.W.; Wang, K.; Gronsky, R.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Detailed high-resolution electron-microscopy studies were applied to identify the atomic structure of the planar defects formed in YBCO ($YBa_2Cu_3O_{7-\delta}$) as a result of exposure to oxygen. The analysis involved computer simulation of images and comparisons with experimental images, evaluated at the atomic level through side-by-side matching of intensity-line scans across image pairs. This process is illustrated in Figure 2.1. The best fit between experimental and calculated images was obtained for the model in which Cu-O-Cu-O... chains occur in the direction of the displacement required to accommodate the extra CuO layer. This means that a shift along the b axis of the orthorhombic cell will leave the oxygen atoms at their original positions, whereas a shift along the a axis will lead to a rearrangement of the oxygen atoms in both CuO planes, such that the Cu atoms will occupy the originally vacant sites. Only in this way can the planar fourfold coordination of Cu be maintained. A secondary result of this study was that the presence of oxygen in the conduction planes could be detected directly in the images. Differences were observed at the location of oxygen-bearing columns of atoms along the beam direction when the specimen was imaged in a [100] direction as compared to a [010] direction. This was only possible because the performance of the microscope was sufficient to discriminate all cation positions, i.e., Ba, Y, and Cu.

47198 (LBL–26455, pp. 2-4) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Continuing work is listed by thesis topic, followed by the graduate students responsible for the research: metallic contacts to $YBa_2Cu_3O_{7-\delta}$, M. Tidjani; grain-boundary structure in $YBa_2Cu_3O_{7-\delta}$, L. Yamamoto; the semiconductor interface to $YBa_2Cu_3O_7$ thin films, K. Atwal; structural transitions and effect of transition-metal doping in $Bi_2SrCa_2Cu_2O_{8+\delta}$ superconductors, C. Burmester, M. Fendorf, and K. Fortunati (work supported by DARPA through TCSUH); corrosion susceptibility and grain boundaries in stainless steel, C. Willis; and multilayers for x-ray optical applications, T. Nguyen. Postdoctoral scientist Judith Ulan is investigating the microstructure of new zeolites in collaboration with S-Cal and Georgia Tech.

47199 (LBL–26455, pp. 6-7) **Microstructures and dielectric properties at the morphotropic phase boundary (MPB) of the $PbTiO_3$-$PbZrO_3$ system.** Yamamoto, T.; Okazaki, K.; Dass, M.L.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Microstructures and dielectric properties near the MPB of the $PbTiO_3$-$PbZrO_3$ system have been investigated. The coexistence of both tetragonal (T) and rhombohedral (R) phases has been confirmed in the PMB of the $Pb(Zr_{0.53}Ti_{0.47})O_3$ specimen by convergent-beam diffraction (CBD) techniques. In the case of PZT, the point groups of the ferroelectric T and R crystal symmetries are 4mm and 3m, respectively. In CBD, the intensity variations in the diffracted beams provide a wealth of information. The [100] CBD patterns obtained form the T $[Pb(Zr_{0.45}Ti_{0.55})O_3]$ and R $[Pb(Zr_{0.35}Ti_{0.65})O_3]$ phases are shown in Figures 5-1 and 5-2, respectively. In the case of CBD patterns from the T phase, the intersection of Kikuchi lines within the [010] Kikuchi band (shown by the arrow in Figure 5-1) is symmetric only with respect to the mirror along [001]. On the other hand, the intersections of Kikuchi lines in the CBD pattern of the R phase (figure 5-2) are symmetrical only in the indicated [110] planes. Figures 5-3 and 5-4 show the bright-field images obtained from both the T and R phases. These phases do not coexist in any one grain but only in each independent grain in the MPB specimen. The domain structures are almost similar in either case, and these phases can thus only be identified by CBD analysis, not by images.

47200 (LBL–26455, pp. 23-24) **High-resolution electron microscopy and image-simulation studies of superconducting polytypoids in Bi-Ca-Sr-Cu-O ceramics.** Hetherington, C.J.D.; Ramesh, R.; O'Keefe, M.A.; Kilaas, R.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

High-resolution electron microscopy of two superconducting polytypoids has been carried out, and image simulation and matching have been used to investigate their structures. The authors have confirmed the stacking sequence of the cations in the c = 30.5-Å polytypoid as Bi-Bi-Sr-Cu-Ca-Cu-Sr-Bi-Bi..., while the 37-Å polytypoid contains one additional set of Cu + Ca layers in each half of the unit cell. Figure 3-1 shows an example of a micrograph taken on the ARM that identified a region as a uniform 37-Å polytypoid. They have also examined the possibility that the HREM images can give further information about the structures using image processing and simulation. The results suggest that (i) in some regions Bi replaces ca, (ii) the oxygen atoms in the Bi bilayers are located at the face centers of the Bi sublattice, and (iii) the central Cu-O layer in the 37-Å polytypoid may be oxygen deficient.

47201 (LBL–26455, pp. 24) **Atomic structure of grain boundaries and surfaces in $YBa_2Cu_3O_{7-\delta}$ and $LaBaCaCu_3O_{7-\delta}$.** Zandbergen, H.W.; Gronsky, R.; van Tendeloo, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

High resolution electron-microscopy studies of grain boundaries and fractured surfaces in both the tetragonal and orthorhombic phases of dense (> 90%) $YBa_2Cu_3O_{7-\delta}$ and tetragonal $LaBaCaCu_3O_{7-\delta}$ are found to be frequently parallel to a (001) plane of one of the adjacent grains, with a structure similar to that of the (001) surface of fractured $YBa_2Cu_3O_{7-\delta}$. Matching of experimental and calculated images shows the outermost surface layer in this compound is a deformed BaO layer. Both grain boundaries and fractured surfaces in $LaBaCaCu_3O_{7-\delta}$ show no such tendency for preferential orientation of the interface plane. Results indicate that the low critical currents observed in sintered materials are caused by textured grain growth in combination with the atomic structure of the grain boundary plane, and the intercalation of off-stoichiometric species near the grain boundary.

47202 (LBL–26455, pp. 24) **Transmission electron microscopy (TEM) characterization of precipitates.** Dahmen, U. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This paper reviews the methods and principles underlying the structural and morphological characterization of precipitates by TEM. Precipitate contrast mechanisms are reduced to the better-known contrast behavior of crystal defects, such as dislocation loops, dipoles, and stacking faults. Because of their importance, basic techniques of controlled specimen tilting and the analysis of double diffraction are treated in some detail. The remainder of this paper concentrates on more advanced concepts in precipitate characterization, not available in textbooks. Emphasis is placed on the use of crystal symmetry in practical problems of precipitate analysis, on the relationship between transformation strains of the real and the reciprocal lattice, and on the connection between transformation strain and morphology. These concepts are illustrated with selected examples.

47203 (LBL–26455, pp. 28) **Rapid solidification of alumina-zirconia eutectic and hypoeutectic alloys.** Whitney, T.; Jayaram, V.; Levi, C.G.; Mehrabian, R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A technique has been developed to produce rapidly solidified fine powders of binary ceramic alloys by electrohydrodynamic (EHD) atomization. Eutectic (42.5 wt%) and hypoeutectic (17 wt%) alumina-zirconia mixtures were prepared by colloidal chemistry methods, extruded, and sintered to form thin rods that were subsequently atomized. Powders from tens of nanometers to the

hundred micrometer range were produced in this manner. Scanning and high-voltage transmission electron microscopy of these materials revealed a variety of microstructures, including completely amorphous particles, single-phase microcrystalline solid solutions, and two-phase mixtures of Al_2O_3 and ZrO_2. Although zirconia appeared predominantly in the monoclinic form, alumina exhibited a multiplicity of metastable crystal structures, including cubic spinel (γ), orthorhombic ordered spinel (δ), and monoclinic (θ). Microstructure evolution is discussed in terms of composition and particle size, hence achievable supercooling with particular emphasis on phase selection and solute redistribution.

47204 (LBL–26455, pp. 28) **An electron microscopy study of the atomic structure of a mullite in a reaction-sintered composite.** Schryvers, D.; Srikrishna, K.; O'Keefe, M.A.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The mullite matrix of a reaction-sintered mullite/zirconia composite has been characterized by various electron microscopy techniques. The mullite was determined to be stoichiometrically $Al_{4.76}Si_{1.23}O_{9.61}$ (1.7:1 mullite), with a disordered vacancy structure and Pbam symmetry. The atomic structure of the mullite has been described in terms of an average unit cell.

47205 (LBL–26455, pp. 29-35) **Structure of δ_2-$Y_2Si_2O_7$ confirmed by processing and simulation of atomic resolution images.** Rai, R.S.; O'Keefe, M.A.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Although high-resolution images of δ_2-$Y_2Si_2O_7$ are extremely noisy due to the presence of a non-crystalline glassy phase, it is possible to extract the periodic component of the image sufficiently well to enable a structural model based on diffraction information to be confirmed by matching of experimental and simulated images. This procedure can be carried out even for the case of a crystal tilted off exact orientation, provided that a sufficiently thin crystal edge can be found. In this case, high-resolution TEM imaging has confirmed the model postulated for the structure of the phase δ_2-$Y_2Si_2O_7$, obtained with NCEM's ARM, were processed by masking the diffractogram of the digitized image in Fourier space and applying an inverse transform in order to reveal details obscured by amorphous contrast originating in the glassy matrix. When these processed experimental images were compared with images simulated from postulated models (SHRLI images); close agreement was obtained. Figure 21-1 demonstrates how the match between the simulated image and the processed image (insert) confirms the postulated model, and shows that the large black spots are at the positions of the yttrium atoms in the structure.

47206 (LBL–26455, pp. 36-37) **TEM studies on the annealing of $YBa_2Cu_3O_{7-\delta}$.** Monteiro, O.R.; Johnson, S.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Annealing in oxygen-rich atmosphere at intermediate temperatures (400-600°C) has been proven necessary to provide the appropriate microstructure of the superconducting $YBa_2Cu_3O_{7-\delta}$. The symmetry of the orthorhombic phase requires that if more than one type of twin plane is present within a grain, a distorted region should exist inside the multiple-twinned grain. This distorted region hinders the tetragonal-to-orthorhombic transformation and may account for some retained tetragonal phase inside an otherwise orthorhombic grain. Figure 3-1 shows the advancement of two twin regions (tips indicated by arrows) from the grain boundary into an adjacent grain of $YBa_2Cu_3O_{7-\delta}$. A physical model describing the formation of such regions, and their eventual transformation into low-angle grain boundaries after long annealing, is presented. Extended annealing at intermediate temperatures apparently leads to the formation of planar faults in off-stoichiometric samples. Transmission electron-microscope image contrast and energy-dispersive x-ray analyses of highly defective regions suggested these defects to be extra CuO_x(x = 1,2) layers that result from the slight copper enrichment in the $YBa_2Cu_3O_{7-\delta}$ used here. These extra layers tend to form near grain boundaries or free surfaces, where oxygen is readily available.

47207 (LBL–26455, pp. 40) **Thermodynamics of oxygen ordering in $YBa_2Cu_3O_z$.** Wille, L.T.; Berera, A.; de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The ordering in the Cu-O basal plane of $YBa_2Cu_3O_z$ is investigated as a function of oxygen content and temperature. Several phase diagrams are calculated by means of the cluster variation method applied to asymmetric two-dimensional Ising models. The interaction parameters selected guarantee the stability of the orthorhombic structures near z = 7, and, for certain choices, also include a double-cell phase around z = 6.5. O-Cu-O correlations are investigated as a function of temperature and concentration. Calculated orthorhombic-to-tetragonal transition temperatures and concentrations for various oxygen partial pressures are in excellent agreement with recent experimental data.

47208 (LBL–26455, pp. 44-45) **Comparison of sizes calculated for MgO crystals from x-ray diffraction (XRD) line broadening to transmission electron microscopy (TEM) observations.** Kim, M.G.; Cima, M.J.; Searcy, A.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

It is shown by examples that for some decomposition reactions XRD line-broadening measurements overestimated the product particle sizes. Particle sizes of MgO from decomposition of $MgCO_3$ and of $Mg(OH)_2$ in vacuum were calculated from XRD line-broadening experiments for comparison to direct observations of particle dimensions by TEM. When $MgCO_3$ is decomposed, the MgO forms with a range of orientations, and the MgO particle sizes calculated from line broadening, 4.5 $\pm$ 0.8 nm, agreed reasonable well with TEM observations, 3.2 $\pm$ 0.8 nm. When $Mg(OH)_2$ is decomposed, the MgO particles are all aligned, and the smallest reported XRD cross sections are more than twice the cross sections directly observed, 0.8 to 2.4 nm. Furthermore, although the cross sections observed by TEM for MgO formed from flakes of $Mg(OH)_2$ decomposed in vacuum are independent of the size of the parent $Mg(OH)_2$ flake, the apparent size of the aligned MgO particles calculated from XRD data increase with thickness of the parent flakes.

47209 (LBL–26455, pp. 45) **The formation of barium titanate ceramics by solid-state reaction.** Bierach, J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Investigations of the industrially important $BaCO_3$ – TiO_2 reaction have commonly reported that, while $BaTiO_3$ forms readily, nucleation barriers inhibit formation of $Ba_4Ti_{13}O_{30}$ and $BaTi_4O_9$, which are stable phases with compositions between $BaTiO_3$ and TiO_2. A computer-assisted evaluation of the variations in XRD peak positions and intensities with time of heating of $BaTiO_3$ with TiO_2 shows that these two intermediate phases also form readily. They are present in low quantities and have probably been overlooked because of overlap of major XRD peaks with those of reactants and of $BaTiO_3$.

47210 (LBL–26455, pp. 46) **Ceramic interfaces.** Glaeser, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Numerous properties of ceramics depend strongly on microstructure, necessitating control of microstructural characteristics developed during processing. This research program focuses on improving the authors understanding of processes that dictate the microstructural changes occurring during processing and utilization. A broad range of model experiments utilizing photolithographically introduced, micro-designed, intragranular, or intergranular pore/flaw structures have been developed and applied to studies of the kinetics of interfacial processes. Phenomena amenable to study include: pore-grain boundary separation, pore coarsening or elimination, faceting (surface-energy anisotropy), and high-temperature

crack healing. In addition, microstructure developed in model compacts formed from an ideal, nominally monodispersed, chemically synthesized titania powder is being examined by applying transmission electron microscopy to ultramicrotomed sections of heat-treated compacts. The effects of crystallization, polymorphic phase transformations, and particle substructure on microstructural evolution are being studied.

47211 (LBL–26455, pp. 46-47) **Applications of microdesigned interfacial pore structures to kinetic studies in ceramics.** Roedel, J.; Glaeser, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A broad range of new model experiments for systematic study of processes that dictate microstructural evolution during sintering and high-temperature use of ceramics has been developed and applied to fundamental kinetic studies of alumina. Photolithographically introduced controlled-geometry surface structures are transformed into interfacial pore structures via hot pressing. Low-misorientation bicrystals with controlled-diameter, controlled-aspect-ratio pore channels have been used to study the effects of geometrical parameters and surface crystallography on the morphological evolution of pore channels in alumina at 1,800°C. A technique for investigating the elimination and coarsening of model pore arrays was developed. Preliminary studies of high-temperature crack healing have been conducted. A model experiment has been developed that allows the study of pore drag and pore-boundary separation under conditions of constant density. Photolithography, ion-beam etching, and hot pressing were used to generate microdesigned interfacial pore arrays, consisting of pores of controlled size and spacing, in alumina. To their knowledge, the authors are the first to provide an experimentally determined map of pore-boundary separation conditions for a ceramic material.

47212 (LBL–26455, pp. 47-48) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Previous work characterizing microstructural evolution in chemically synthesized titania powders established the importance of phase transformations that occur within nanometer diameter particles, at low temperatures, and at low relative densities. Current efforts are focused on developing and improving ultramicrotomy procedures for preparation of foils for high-resolution transmission electron microscopy (TEM) studies, and subsequent characterization of microstructural evolution within annealed, low-density powder compacts. The techniques for embedding ceramic-powder compacts in resins for ultramicrotomy were not well established. Infiltration and curing procedures were developed that produced material suitable for ultramicrotomy. Compacts constituted of nominally mono-dispersed, ≈ 0.37-μm-diameter titania powders have been annealed for times ranging from 6 min to 122 hr at temperatures from 400°C to 825°C, microtomed, and then studied by TEM. Results confirm that the as-prepared ≈ 0.37-μm-diameter powders consist of fine 7-nm-diameter amorphous primary particles. During annealing at 400°C, crystallization occurs. Experiments suggest that the phase content, grain size, and degree of grain growth or phase-transformation-front propagation across interparticle necks during higher-temperature ({ >=} 650°C) annealing are highly sensitive to thermal pretreatment in the 400°C to 500°C temperature range. Work utilizing prismatic-plane sapphire is in progress, in an effort to understand the effects of MgO on migration rates and pore-boundary separation conditions for grain boundaries of differing structure.

47213 (LBL–26455, pp. 79-80) **Atomic arrangement and electronic structure of BC_2N.** Liu, A.Y.; Wentzcovitch, R.M.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Recently a hybrid of composition BC_2N has been synthesized using chemical vapor deposition (CVD) with BCl_3 and CH_3CN as the starting materials. X-ray diffraction indicates that this new material consists of irregularly stacked hexagonal sheets with an intralayer lattice constant (a = 2.44 Å) and an interlayer distance (C = 3.40 Å) very close to the values in graphite. Although the x-ray data do not yield the atomic arrangement within the planes, the fine structure in the electron-energy-loss core edges show that all three atomic species in BC_2N participate in sp^2-type bonding. Hence the atoms are expected to be arranged in planes of graphite-like hexagonal rings, with weak interplanar interactions. At this time, it is unclear whether BC_2N is semimetallic or semiconducting. While conductivity measurements of BC_2N indicate that it is a narrow-gap semiconductor, x-ray photoemission experiments suggest that it is metallic. Three possible geometries are investigated for the BC_2N monolayer. The calculations are done using the first-principles pseudopotential local-orbital method. The local-density approximation with the Wigner form of the exchange and correlation functional is used. The electronic wave function is expanded in a linear combination of Bloch sums of orbitals localized on the atomic sites.

47214 (LBL–26455, pp. 80) **Structural and electronic properties of WC.** Liu, A.Y.; Wentzcovitch, R.M.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The results of a pseudopotential local-orbital calculation on hexagonal WC yields calculated lattice constants and cohesive energy in good agreement with experiment, and the calculated bulk modulus lies within the wide range of measured values. The band structure and Fermi surface obtained are also generally consistent with experimental data, and the Fermi level is found to lie in a deep minimum of the density of states. The calculated valence-electron charge density indicates that the bonding in WC consists of a metallic component similar to that found in solid W, and strong W-C bonds.

47215 (LBL–26455, pp. 90) **Specific heat of $YBa_2Cu_3O_7$.** Fisher, R.A.; Gordon, J.E.; Kim, S.; Phillips, N.E.; Stacy, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The specific heats of a number of new samples of YBCO made at LBL and also in other laboratories have been measured. Evidence for an intrinsic linear term, $\gamma(0)T$, in the zero field has continued to accumulate, but $\gamma(0)$ may be closer to 4.5 or 5 than the 6 or 7 mJ/mole x K_2 obtained in earlier measurements. There is no doubt that magnetic impurity phases contribute to the observed $\gamma(0)$, but it continues to appear that there is an intrinsic component that persists in the pure YBCO limit. This point is of considerable interest in connection with theory - the existence of a nonzero $\gamma(0)$ is an important prediction of one of the major theories.

47216 (LBL–26455, pp. 90-91) **Specific-heat measurements on superconducting Bi-Ca-Sr-Cu and Tl-Ca-Ba-Ca oxides: Absence of a linear term in the specific heat of Bi-Ca-Sr-Cu oxides.** Morris, D.E. (Lawrence Berkeley Lab., CA (USA)); Markelz, A.G.; Wei, J.Y.T.; Ginley, D.S.; Fisher, R.A.; Kim, S.; Lacy, S.E.; Phillips, N.E. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Measurements on a number of samples of Bi-Cu oxides have shown that $\gamma(0)$ is an order of magnitude smaller than in YBCO, and zero within the experimental uncertainty. The reason for this difference is not clear at this time, but even if $\gamma(0) \neq 0$ is an intrinsic property of all high-T_c oxide superconductors, it seems quite possible that it might assume different values in different materials. The Tl-Ca-Ba-Cu oxide investigated showed a linear term comparable to those found in YBCO (see Figure 4-1).

47217 (LBL–26455, pp. 99) **Laser-pulse vaporization of uranium dioxide and other refractory materials.** Olander, D.R.; Yagnik, S.K.; Tsai, C.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The nature of the vapor produced by pulse surface heating of UO_2 and several other materials was investigated using normal-mode laser pulses with peak-power densities between 10^4 and 10^6 W/cm^2. Maximum surface temperatures measured by optical pyrometry ranged from 1,900 to 4,200 K. At temperatures below ~

2,400 K for UO_2, the vapor pulse followed the Hertz-Langmuir vacuum-vaporization theory. More energetic transients produced gas-dynamic blowoffs accompanied by significant super-saturation in the expanding plume. Neutron-activation analysis of the collected vapor indicated that the total quantity of liquid UO_2 evaporated in the pulse followed the Hertz-Langmuir formula. However, mass-spectrometric analysis of the emitted vapor showed large deviations in the quantity and waveform shape of the monomer species. These and other features of the blowoff were satisfactorily explained in terms of nucleation and growth of polymeric species. Although UO_2 clusters were undetectable by the mass spectrometer, polymers, of MgO and ZrO_2 were observed.

47218 (PNL-SA-18383) **Particle network rearrangement during pressure filtration and sedimentation: Analysis by gamma-ray densitometry.** Schilling, C.H. (Pacific Northwest Lab., Richland, WA (USA)); Lannutti, J.J.; Aksay, I.A. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900736-3: Conference on nondestructive evaluation of modern ceramics, Columbus, OH (USA), 9-12 Jul 1990). Order Number DE90016534. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent studies show that properties of sintered ceramics can be significantly affected by particle packing defects that evolve prior to sintering. For example, reduced fracture strengths are often attributed to differential shrinkage stresses incurred during drying and sintering operations; these stresses result from large pores and variations in packing structure uniformity. Regulating these defect populations requires a better understanding of how physical parameters affect processes of agglomerate restructuring and pore closure during successive processing stages (suspension preparation, shape-forming, drying, and sintering). In particular, effects of dispersant chemistry on ceramic particle rearrangement are poorly understood; improved analytical methods are necessary to evaluate the influences of solution chemistry parameters on rearrangement forces at particle-particle interfaces.

47219 (SAND-89-2771C) **Renormalization from density functional theory strong coupling models for the electronic structure of La_2CuO_4.** Hybertsen, M.S. (AT and T Bell Labs., Murray Hill, NJ (USA)); Schluter, M.; Stechel, E.B.; Jennison, D.R. Sandia National Labs., Albuquerque, NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891119-136: Materials Research Society fall meeting, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE90015990. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Strong coupling models for the electronic structure of La_2CuO_4 are derived in two successive stages of renormalization. First, a three-band Hubbard model is derived using a constrained density functional approach. Second, exact diagonalization studies of finite clusters within the three band Hubbard model are used to select and map the low energy spectra onto effective one-band Hamiltonians. At each stage, some observables are calculated and found to be in quantitative agreement with experiment. The final results suggest the following models to be adequate descriptions of the low energy scale dynamics: (1) a spin 1/2 Heisenberg model for the insulating case with nearest neighbor J≈130 meV; (2) a "t – t' – J" model with nearly identical parameters for the electron and hole doped cases. 14 refs., 2 figs., 1 tab.

47220 **An in-situ, high-temperature study of the superconductor $YBa_{1.67}Sr_{0.33}Cu_3O_{6+x}$.** Faber, J. Jr. (Argonne National Lab., Materials Science Div., Argonne, IL (US)); Shaked, H.; Veal, B.W.; Hitterman, R.L.; Paulikas, A.P.; Nowicki, L.J.; Downey, J.W. pp. 149-160 of Advanced characterization techniques for ceramics: Volume 5. Young, W.S.; McVay, G.L.; Pike, G.E. American Ceramic Society Inc., Columbus, OH (USA) (1988). DOE Contract W-31109-ENG-38. (CONF-8810195-: 41. Pacific coast regional meeting of the American Ceramic Society, San Francisco, CA (USA), 24-26 Oct 1988).

The technique of analyzing property behavior of ceramic materials under in-situ conditions has been used to study the high-T_c, Sr-doped 123 material, $YBa_{1.67}Sr_{0.33}Cu_3O_{6+x}$ at high temperature. An order-disorder transition is observed at T = 650C. Upon heating, the crystal symmetry changes from orthorhombic (Pmmm) below the transition to tetragonal (P4/mmm) above. The mechanism of the phase transition involves the redistribution of anions on the O(1) and O(5) sites. These sites become equivalent in the high temperature phase. In addition, the anions on these lattice sites do not exhibit temperature-dependent thermal vibration behavior, indicating that this behavior is dominated by static displacements due to nonstoichiometric disorder.

47221 **Characterization of ceramic superconductors by magnetically modulated microwave reflection (MMR).** Dalal, N.S. (Dept. of Chemistry, West Virginia Univ., Morgantown, WV (US)); Mahl, T.A.; Kahol, P.K.; DeLooze, J.P.; Moodera, J.S.; Bhalla, A.S. pp. 199-205 of Advanced characterization techniques for ceramics: Volume 5. Young, W.S.; McVay, G.L.; Pike, G.E. American Ceramic Society Inc., Columbus, OH (USA) (1988). (CONF-8810195-: 41. Pacific coast regional meeting of the American Ceramic Society, San Francisco, CA (USA), 24-26 Oct 1988).

A microwave technique is described which provides a novel, contactless procedure for the characterization of high T_c ceramic superconductors. The method utilizes a standard electron paramagnetic resonance (EPR) spectrometer. The output signal is proportional to changes in the magnetically-modulated microwave reflection (MMR). The MMR methodology appears to have the potential for becoming a quick highly-sensitive, and non-abrasive technique for determining the T_c and the relative superconducting quality of a large number of samples. The technique is illustrated by its application to variously prepared Yba_2CU_3O- x samples.

47222 **Thermal shock resistance characterization of cellular alumina ceramics.** Orenstein, R.M. (Oak Ridge National Laboratory, TN (USA)); Green, D.J. pp. 641-650 of Ceramic materials and components for engines; Proceedings of the Third International Symposium, Las Vegas, NV, Nov. 27-30, 1988. Tennery, V.J. American Ceramic Society, Inc., Westerville, OH (US) (1989). (CONF-881125-: 3. international symposium on ceramic materials and components for engines, Las Vegas, NV (USA), 27-30 Nov 1988).

Cellular ceramic materials can find important uses in advanced heat engines. Strength, toughness and elastic moduli decrease in these materials as a function of density. Thermal shock resistance parameters can be modeled in order to predict environmental limitations and failure mechanisms due to thermal cycling. Specimens of a commercial lightweight alumina-mullite ceramic were quenched in water from temperatures ranging to 1000 C. Crack extension follows theoretical predictions if material properties of the solid phase are used in calculations. Theoretical predictions of macrocracking behavior in the bulk material are partially supported by experimental results, but quench medium infiltration into the bulk specimens limits attainable temperature differences. Thermal shock resistance on a macroscopic scale is higher than expected from calculations based on bulk properties. Thermal shock resistance of the solid phase can be tailored by altering the composition, microstructure and dimensions of the material. 15 refs.

47223 **Crystal structure of nonsuperconducting $Pb_2(Sr_{0.94}Nd_{0.06})_2(Nd_{0.76}Sr_{0.24})Cu_3O_8$.** Hayri, E.A. (Brookhaven National Lab., Upton, NY (USA)); Kvick, A. *Journal of Solid State Chemistry (USA)*, 84(1): 144-152 (Jan 1990). DOE Contract AC02-76CH00016.

The crystal structure of $Pb_2(Sr_{0.94}Nd_{0.06})_2(Nd_{0.76}Sr_{0.24})Cu_3O_8$ was determined by single crystal x-ray diffraction. The compound was found to be orthorhombic (Cmmm) with a = 5.437(3), b = 5.472(2), c = 15.797(7) Å and Z = 2. In the structure double layers of CuO square pyramids are separated by (Nd, Sr) oxygen deficient layers which are stacked between (PbO)-Cu-(PbO) slabs. The oxygen in the Pb planes is shifted toward a pair of Pb atoms resulting in an orthorhombic distortion of the tetragonal unit cell. The possibilities for modulations and superlattices are discussed as is the role of the PbO planes in superconductivity.

47224 **Point defects and surface diffusion in iron oxide and nickel oxide.** Lin, C.M. (Pennsylvania State Univ., University Park, PA (USA). Dept. of Materials Science and Engineering); Stubican, V.S. *Journal of the American Ceramic Society (USA)*, 73(3): 587-591 (Mar 1990).

This paper reports diffusion of the ^{57}Co isotope on Fe_3O_4 (110) and NiO (100) surfaces investigated by the edge-source method. The surface diffusion parameter $_s\delta$, where α is the segregation factor, $_s$ the surface diffusion coefficient, and δ the thickness of the high-diffusivity layer, was determined at 750°C for different partial pressures of oxygen. In both cases point defects strongly influenced surface diffusion. For Fe_3O_4 the vacancy mechanism is dominant at high oxygen activities and interstitial (or interstitiacly) mechanism dominates at low oxygen activities. For NiO the surface diffusion at low oxygen activities is influenced by aliovalent impurities and at a high oxygen activities the strong influence of the intrinsic defects, nickel vacancies, on surface diffusion was observed. It is concluded that similar mechanisms operate during surface diffusion in the near surface layer and during diffusion in the lattice.

47225 Ferroelectric domain structure of lanthanum-modified lead titanate ceramics. Demczyk, B.G. (California Univ., Berkeley, CA (USA). Dept. of Materials Science and Mineral Engineering); Rai, R.S.; Thomas, G. *Journal of the American Ceramic Society (USA)*, 73(3): 615-620 (Mar 1990).

The ferroelectric domain configurations in lanthanum-modified lead titanate ceramics have been studied by transmission electron microscopy in conventional, analytical, and high-resolution modes. Results indicate a preponderance of {101}, twin-related 90° domains of equilibrium width 50 to 100 nm. These values are consistent with those derived from consideration of elastic strain energy. Below a critical grain size of approximately 0.3 μm, single-domain grains are found. A domain wall energy of 1 mJ/m^2 was calculated based on this observation. Within such twins are occasionally found ordered domains, displaying little or no misorientation with respect to one another. In addition, {001}, 180° domains were observed.

47226 X-ray absorption spectroscopy, x-ray photoelectron spectroscopy, and analytical electron microscopy studies of cobalt catalysts. 2. Hydrogen reduction properties. Castner, D.G. (Chevron Research Co., Richmond, CA (USA)); Watson, P.R.; Chan, I.Y. *Journal of Physical Chemistry (USA)*, 94(2): 819-828 (25 Jan 1990).

XAS, XPS, AEM, and temperature-programmed reduction were used to characterize the hydrogen reduction of bulk Co_3O_4 and Co_3O_4 supported on small (Co/SiO_2-62) and large (Co/SiO_2-923) pore size silica. The reduction process proceeded as $Co_3O_4 \rightarrow CoO \rightarrow Co$, with the CoO intermediate species spectroscopically identified on all three samples. The first step of the reduction, $Co_3O_4 \rightarrow CoO$, occurred near 300°C for all three catalysts. The second step of the reduction, $CoO \rightarrow Co$, showed significant differences among the samples, with the ease of reduction decreasing in the order $Co_3O_4 > Co/SiO_2$-62 > Co/SiO_2-923. The ease of reduction appeared to be correlated to the ease of removing the H_2O produced during the $CoO \rightarrow Co$ step. The small pores (ca. 30 Å) of the Co/SiO_2-923 sample made H_2O removal and reduction for that sample the most difficult. Upon reduction of the Co_3O_4 supported particles to metallic Co the particle size decreased by 30-50% due to removal of oxygen from the Co_3O_4 particles. For the reduced Co/SiO_2-62 sample, the Co particles were 90 Å in size and grouped together in 0.1-1-μm aggregates. The crystallographic orientation of the individual particles in each aggregate became radomized upon reduction and reoxidation. For the reduced Co/SiO_2-923 sample the Co particles were 35 Å in size.

47227 Sol-gel antireflective coating on plastics. Ashley, C.S.; Reed, S.T. To Dept. of Energy, Washington, DC (USA). USA Patent 4,929,278/A/. 29 May 1990. Filed date 26 Jan 1988. USA Patent Application 7-148,458. Int. Cl. C09K 3/00. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an antireflection film made from a reliquified sol-gel hydrolyzation, condensation polymeric reaction product of a silicon, alkoxides and/or metal alkoxides, or mixtures thereof. The film is particularly useful for coating plastics.

47228 Method for enhancing growth of SiO_2InSi by the implantation of germanium. Holland, O.W.; Fathy, D.; White, C.W. To Dept. of Energy, Washington, DC (USA). USA Patent 4,920,076/A/. 24 Apr 1990. Filed date 15 Aug 1988. USA Patent Application 7-181,899. Int. Cl. H01L 21/473. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method for enhancing the conversion of Si to SiO_2 in a direction fashion wherein steam or wet oxidation of Si is enhanced by the prior implantation of Ge into the Si. The unique advantages of the Ge impurity include the directional enhancement of oxidation and the reduction in thermal budget, while at the same time, Ge is an electrically inactive impurity.

47229 Grained composite materials prepared by combustion synthesis under mechanical pressure. Dunmead, S.D.; Holt, J.B.; Kingman, D.D.; Munir, Z.A. To Dept. of Energy, Washington, DC (USA). USA Patent 4,909,842/A/. 20 Mar 1990. Filed date 21 Oct 1988. USA Patent Application 7-260,757. Int. Cl. C22C 29/02. 18p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes dense, finely grained composite materials. They comprise one r more ceramic phase or phase and one or more metallic and/or intermetallic phase or phases are produced by combustion synthesis. Spherical ceramic grains are homogeneously dispersed within the matrix. Methods are provided, which include the step of applying mechanical pressure during or immediately after ignition, by which the microstructures in the resulting composites can be controllably selected.

3606 Other Materials

Refer also to citation(s) 46669, 46776, 46797, 46846, 47138, 47139, 47141, 47157, 47182, 47294, 47295, 47299, 47311, 47318, 47356, 47390, 47460, 47468, 47469, 47473, 47483, 47561, 47789, 47926, 47936, 48040, 48043, 48045, 48046, 48047, 48049, 48059

47230 (AD-A-222206/5/XAB) **Electron-beam-enhanced oxidation processes in II-VI compound semiconductors observed by high-resolution electron microscopy.** Thangaraj, N.; Wessels, B.W. Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering. 1 Feb 1990. 8p. Grant AFOSR-86-0344. Source: NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 67, No. 3, 1535-1541(1 Feb 1990).

Enhanced oxidation of ZnS and ZnSe semiconductor surfaces has been observed in situ during electron irradiation in a high-resolution electron microscope. The phase present at the surface region has been identified as ZnO by optical diffractogram and selected area electron diffraction techniques. For ZnS oxidation, both hexagonal ZnO having a random orientation and cubic ZnO in perfect epitaxial relationship with the bulk ZnS were observed. Enhanced oxidation of ZnSe to ZnO has also been observed under electron beam irradiation. However, only the hexagonal form was observed. The oxidation rates for both ZnS and ZnSe depended on electron flux but was independent of orientation. A model in which the oxidation process is limited by diffusion through the oxide film is proposed. By electron irradiation the diffusion rate is enhanced presumably by a nonthermal process.

47231 (AD-A-222257/8/XAB) **Influence of stereochemistry on radiation-induced structural changes in PMMA. Technical report.** Moore, J.A.; Choi, J.O. Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemistry. 31 May 1990. 5p. Contract N00014-85-K-0632. (TR-18). Source: NTIS, PC A01/MF A01.

We have been studying the effects of radiation on poly(methylmethacrylate), PMMA, which has been used as a resist in computer chip microlithography. In contrast to predictions based on solution photochemistry of related compounds we have found by careful spectroscopic study of the irradiation polymer leads to four different kinds of double bonds. These ester cleavage reactions do not necessarily lead to rupture of the backbone, a necessary condition for efficient use as a resist. We find evidence that not only does the state (solution vs. film) upon which irradiation is carried out affect the product distribution, but also that the stereochemistry of PMMA (atactic vs. isotactic) plays a role.

47232 (CNIC-00249) **Investigation of methods to prepare carbon foils and to determine their thicknesses.** Xu Guoji (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy);

Guan Shouren; Luo Xinghua; Meng Xiangjin. China Nuclear Information Centre, Beijing, BJ (China). 1988. 7p. (In Chinese). (IAE–0061). Order Number DE90638126. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The development and study of methods to prepare carbon foils and to determine their thicknesses are described. The methods of making carbon foils consist of carbon-arc evaporation, resistance heating, electron bombardment, cracking ethylene and centrifugal precipitation. Weighing, α-particle measurement, Rutherford backscattering and spectrophotometer are used to determine the thickness of carbon foils.

47233 (DOE/ER/13850–15) **Thermophysical properties of fluids and fluid mixtures: Progress report.** Stell, G. State Univ. of New York, Albany, NY (USA). Research Foundation. Jul 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER13850. Order Number DE90016306. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This progress report, written in July 1990, plays a dual role of our annual progress report and the component of our renewal proposal package that provides in detail the necessary background for the thermophysical research proposed therein. Because of its second role, we shall briefly summarize some overall Grant aims and overall accomplishments, stressing the progress that has been made over the last year. 38 refs.

47234 (DOE/ER/45330–2) **Excitons in semiconducting superlattices, quantum wells, and ternary alloys: Progress report, September 15, 1988–September 14, 1990.** Sturge, M.D. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics); Nahory, R.E.; Tamargo, M.C. Dartmouth Coll., Hanover, NH (USA). Dept. of Physics. 22 Aug 1990. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER45330. Order Number DE90017287. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

It is now possible to fabricated semiconducting layered structures with precisely defined layer thicknesses of a few atomic diameters. Examples are the "quantum well" and the "superlattice" structures, in which semiconductors with different band gaps are interleaved. "Microstructures" can be produced from this material by patterning and etching them on a small (~10nm) scale. Their electronic properties are quite different from those of the constituents and offer interesting new possibilities both in device design and in basic physics. This proposal aims to improve our understanding of optically excited states ("excitons" and "electron-hole plasmas") in these structures. Work will also continue on ternary alloys, primarily to establish if the alloy disorder produces a mobility edge for excitons, and on II-VI compounds, where the principal interest at present is in the nature of the exciton-phonon coupling.

47235 (IS-T–1487) **Monomolecular and thin polymer films: Fabrication, characterization, applications, and models of wetting.** Chau, Lai Kwan. Ames Lab., IA (USA). 24 Aug 1990. 166p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90016415. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

A variety of chemically modified surfaces were synthesized and their molecular structures and reactivities were characterized. These interfaces include: (1) Monomolecular films of n-alkanoic acids ($CH_3(CH_2)_nCOOH$) and n-perfluorocarboxylic acids ($CF_3(CF_2)_nCOOH$) on silver; and (2) calcichrome immobilized at an anion exchange polymer film. The monomolecular films were fabricated by the self-assembly method and characterized by optical ellipsometry, infrared reflection spectroscopy, and contact angle measurements. A comparison is given of the properties of these films with regard to composition, defectiveness, intermolecular environment, molecular orientation, wettability, and formation thermodynamics. As it is relevant to monolayer formation thermodynamics, the isoelectric point of the surface of evaporated silver films was determined by contact angle titration. Potential applications of these films are discussed. Monomolecular films as models of wetting are also examined in terms of van der Waals interactions at the macroscopic interfaces. Theoretical considerations of the effects of intermolecular forces on depth sensitivity of wetting and limiting contact angles of various systems are assessed. One of the synthesized interfaces has been applied as a Ca(II) optical sensor. The sensor was fabricated by electrostatic immobilization of calcichrome at an anion exchange polymer film. The structure and reactivity of this interface was characterized by ultraviolet-visible diffuse reflectance spectroscopy and infrared photoacoustic spectroscopy. Equations to determine the metal complex formation constant and acid dissociation constants of the immobilized reagent form diffuse reflectance spectra are developed. Possible causes affecting the reactivity of an immobilized indicator are discussed.

47236 (K/QT–331) **Evaluation of available perfluorobutane data for selected physical properties.** Harkins, D. Oak Ridge Gaseous Diffusion Plant, TN (USA). Jan 1990. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE90016516. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A literature search was conducted, and available information accumulated on a short list of six properties of C_4F_{10}. These data have been evaluated as to their applicability and accuracy, and the best results are presented in this report. In general, the properties included in this evaluation are known or approximated with an accuracy of 10% or better. 12 refs., 7 tabs.

47237 (LBL–26455, pp. 6) **Microstructural and magnetic characterization in soft magnetic Fe-Si-Al sendust alloys.** Kim, J.D.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Microstructure and its effect on magnetic domain structure and domain-wall motion have been studied by TEM to understand the role of microstructure in determining the magnetic properties of a soft magnetic Sendust alloy. The B2 → DO_3 phase transition in an $Fe_3Si_{0.6}Al_{0.4}$ Sendust alloy commenced on cooling below 1,030°C and followed a nucleation-and-growth process, developing a two-phase structure. However, since the phase transition could not be suppressed by quenching, the microstructure at room temperature consisted of single-phase DO_3. However, as quenched microstructures from the two-phase region showed interfacial superlattice dislocations bound with antiphase domain boundaries (APBs). These superlattice dislocations have a Burgers vector of the 1/2 <100> type, consistent with their being misfit interfacial dislocations. From in situ studies by Lorentz imaging of domain-wall motion, it was shown that the interactions of domain walls with individual dislocations and PABs are not sufficiently strong to be observed, as domain walls passed straight across them. However, grain boundaries act as strong pinning sites for domain walls and closure domains formed at holes, leading to a retardation of the domain-wall motion. A suggestion for improving Sendust for recording heads is therefore to have clean, nonporous alloys, preferably single crystals, but if not, crystals with very large grain size.

47238 (LBL–26455, pp. 13) **The formation of hexagonal silicon at twin intersections.** Dahmen, U.; Hetherington, C.; Pirouz, P.; Westmacott, K.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

From studies of the microstructure of the heavily deformed zones of hot-indented silicon, it has been postulated that the formation of an observed hexagonal form of silicon has its origin in multiple twinning. A model has been developed, one feature of which is the prediction that under strict plane-strain conditions the region of twin intersection will be forced into hexagonal close-packed stacking to accommodate the strain of crossing twins. Direct confirmation of this prediction has been obtained by high-resolution microscopy performed on NCEM's Atomic Resolution Microscope, as illustrated in Figure 1-1. The hexagonal ABAB atom stacking is clearly visible in the region marked H, which lies at the intersection of twin 1 and twin 2. A schematic diagram showing the lattice changes induced by a sequence of twinning operations given in Figure 1-2 may be compared directly with the observed structure.

47239 (LBL–26455, pp. 14) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A series of papers on the nature and origin of the diamond hexagonal phase in silicon is being prepared for publication (in collaboration with P. Pirouz of Case Western Reserve University). A

comprehensive high-resolution study of germanium precipitation from aluminum has been completed and is being written up for publication. It is shown that multiple twinning of the precipitates is the thread linking the many different precipitate morphologies that are observed. A high-resolution analysis of the fcc/bcc interfaces between matrix and precipitation in a Cu-Cr alloy is being undertaken to complete a detailed study of precipitate crystallography in this classical fcc/bcc alloy system (in collaboration with M.J. Witcomb, University of the Witwatersrand, Johannesburg, South Africa).

47240 (LBL–26455, pp. 24-25) **Transmission electron microscope study of arsenic precipitates in GaAs: Morphology and orientation relationship with the matrix.** Lee, B.T.; Gronsky, R.; Bourret, E.D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Precipitates in several GaAs crystals with different properties were studied with transmission electron microscopy to reveal their identity, their orientation relationship with the matrix, and their morphology. Most of them were identified as elemental rhombohedral As with a tetrahedral shape bounded by GaAs (111) planes. Some of the As precipitates showed a simple orientation relationship with the matrix: (0001)As || (111)GaAs and (1120)As || (110)GaAs. It was found that this orientation relationship yields a high degree of structural coherence between the two phases and is responsible for the observed tetrahedral precipitate shape. Other As particles associated with dislocations showed a less coherent orientation relationship, with a few-degree variation from the above relationship, likely due to strain around the dislocation core.

47241 (LBL–26455, pp. 25) **Electron-energy-loss spectroscopy (EELS): Fundamentals and applications in the characterization of minerals.** Krishnan, K.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The combined use of an energy-loss spectrometer and an analytical electron microscope with fine probe-forming capabilities provides a wealth of information about the samples at high spatial resolution. Fundamental principles governing the physics of the interaction between the fast electron and a thin foil sample, to account for the the fine structure in the inelastically scattered fast-electron distribution (EELS), are reviewed. General application of EELS is in the area of microanalysis of low-atomic-number elements ($Z > 11$), where it significantly complements the more widely used energy-dispersive x-ray (EDX) spectroscopy. However, a careful analysis of the low-loss plasmon oscillations and the fine structure in the core-loss edges can provide additional information related to the bonding and electronic structure of the sample. An illustration of this is presented from their study of Cδ diamond residue from the Allende carbonaceous chondrite. The combination of EELS with channeling effects can provide specific site-occupation/valence information in crystalline materials. Details of this novel crystallographic method are outlined and illustrated with an example of the study of chromite spinels.

47242 (LBL–26455, pp. 25) **Structure and bonding of diamond and diamond-like materials: Microanalytical characterization at high spatial resolution.** Krishnan, K.M.; Blake, D.F.; Freund, F.; Lipari, R.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Recent developments in the synthesis of single-phase diamond films and the observation of nanometer-scale diamond-like particles in meteoritic residues have generated much interest in the characterization of these materials. Of particular interest is the evaluation of parameters such as degree of crystallinity, defects, homogeneity, grain size, impurity content, bonding, electronic structure, etc. With the incorporation of fine probe-forming systems in an Analytical Electron Microscope (AEM) and the development of related diffraction, spectroscopic, and imaging methods, it is possible to obtain precisely such structural and chemical information at high spatial resolution. Here the authors summarize the results of their studies of explosively compacted diamond particles, microwave plasma-enhanced chemical-vapor-deposition diamond films, and diamond-like residues of extraterrestrial carbon (Cd residue) by microdiffraction, EDX spectroscopy, and EELS, all using nanometer-scale electron probes, and by electron spectroscopy for chemical analysis, a complementary bulk spectroscopic method. However, the characterization of the Cd residue is particularly emphasized.

47243 (LBL–26455, pp. 27) **Inversion boundaries in GaAs grown on Si.** Liliental-Weber, Z.; O'Keefe, M.A.; Washburn, J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Inversion boundaries in GaAs grown on Si were investigated by high-resolution transmission electron microscopy. These boundaries were found to microscopically follow (110) planes, even when they appeared macroscopically along other planes, such as (111). High-resolution micrographs from edge-on (110) inversion boundaries were taken in (110) and (100) projections. In certain areas, shifts of the images of (111) and (200) planes across the boundaries were observed. Image simulations confirmed that the visibility of these shifts can only be observed for specific imaging conditions and within a limited range of sample thickness.

47244 (LBL–26455, pp. 27) **Dislocation microstructures on flat and stepped Si surfaces: Guidance for growing high-quality GaAs on (100) Si substrates.** Lo, Y.H.; Wu, M.C.; Lee, H.; Wang, S.; Liliental-Weber, Z. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Type-I dislocations at the GaAs/Si interface are beneficial, because they effectively relax the mismatched stress but do not propagate into the GaAs film. Accordingly, the best way to grow a low-defect-density GaAs film on a Si substrate is to form as many as possible type-I dislocations or, equivalently, to suppress other kinds of defects. This high-resolution transmission electron microscopy study shows that most of the type-I dislocations are formed at the double step on a Si surface. It is further determined that the silicon surface steps are mainly caused by the substrate's tilting instead of heating before growth. Based on their study, the (100) Si substrate with double steps along both (110) and (110) axes provides the best condition for growing low-defect-density GaAs on Si substrates.

47245 (LBL–26455, pp. 28-29) **Interphase composition profile in Sb/SBS block copolymers, measured with electron microscopy, and microstructural implications.** Spontak, R.J.; Williams, M.C.; Agard, D.A. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The behavior of microphase-separated block copolymers has major contributions from the mixed interphase existing between the two homogeneous phases. However, relatively little has been known about the interphase itself, and in particular, its composition profile has never been measured directly. Here they have used quantitative transmission electron microscopy to acquire the shape of the volume-fraction composition profile across this interphase. Measurements were made on four styrene (S)/butadiene (B) block copolymers having structure SBS (three) and SB (one), with molecular weights 1.0-2.3 x 10^5 g/mol and overall volume compositions of 0.24-0.38 styrene. Results, averaged over the four samples, depict an asymmetric interphase profile rich in styrene (54 vol%), in agreement with new differential scanning calorimetry data and with dynamic mechanical testing studies of others. This profile is then used in an equilibrium thermodynamic theory (which extends earlier work by adding an enthalpic Debye term that accounts for molecular interactions beyond nearest neighbors) to predict various microstructural and thermal properties of the bulk polymer. Excellent agreement with reported data is obtained for the predicted interphase thickness and interphase volume fraction and for predictions of the repeat distance for lamellar SB copolymers.

47246 (LBL–26455, pp. 36) **Oxidation of indium phosphide.** Monteiro, O.R.; Evans, J.W. Lawrence Berkeley Lab., CA (USA).

Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Despite industrial interest in producing a dielectric layer on indium phosphide, its thermal oxidation is not fully understood. This article describes some results obtained from observing the oxidation reaction inside a transmission electron microscope. At temperatures between 450 and 600°C, In_2O_3 and $InPO_4$ are produced. Polycrystalline In_2O_3 appears to be produced during simultaneous incongruent vaporization, which takes place above 362°C. At the early stages of the reaction, $InPO_4$ grows epitaxially on the InP, but later it transforms into polycrystalline $InPO_4$.

47247 (LBL–26455, pp. 36) **Oxidation of gallium arsenide.** Monteiro, O.R.; Evans, J.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This study has been concerned with the effect of dopants on the oxidation of gallium arsenide. Here the authors present some results of transmission electron microscopy (TEM) and SIMS of thermally oxidized gallium arsenide with different types of dopants. At temperatures below 400°C an amorphous oxide is formed. Oxidation at temperatures between 500°C and 600°C initially produces an epitaxial film of γ-Ga_2O_3. As the reaction proceeds, this film becomes polycrystalline and then transforms to β-Ga_2O_3. This film contains small crystallites of As_2O_5 in the case of Si-doped and Te-doped materials, and some As_2O_3 and As_2O_5 in the case of Cr-doped GaAs. SIMS results showed that in both cases, arsenic accumulates at the interface, and the reduced solubility of As in GaAs results in precipitation of hexagonal As. The chromium-doped and other gallium arsenides also exhibit different oxidation kinetics.

47248 (LBL–26455, pp. 37) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Investigations are in progress on the oxidation of porous silicon and on the reaction of silicon with tungsten hexafluoride.

47249 (LBL–26455, pp. 86) **Comparative study of the density of states of graphite and BC_3.** Wentzcovitch, R.M.; Cohen, M.L.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Calculated results show important differences between the density of states (DOS) of the new layered materials BC_3, and that of graphite. The differences derived from the proposed structure of BC_3 and should provide evidence for the atomic arrangement in this material. Their signature seems to be present in electron-energy-loss (EELS) spectra and could be searched for in other types of experiments that probe the energy distribution of electrons, such as near-edge x-ray absorption fine-structure spectroscopy (NEXAFS).

47250 (LBL–26455, pp. 97) **Modulated molecular-beam studies of the surface chemistry of silicon reaction with reactive gases.** Olander, D.R.; Balooch, M.; Abrefah, J.; Siekhaus, W.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The method of studying the kinetics of gas-solid surface reactions using modulated-molecular beams and mass-spectrometric detection is described. The modulated molecular-beam technique permits mechanistic study of gas-solid reactions that exhibit characteristic reaction times between 10 ms to 10 μs. In situ direct-flight mass-spectrometric detection allows for determination of individual reaction product species. Use of the method is greatly enhanced if related techniques, such as isotopic exchange, temperature-ramp thermal desorption, and surface spectroscopies, are brought to bear on the same reaction. Low-pressure thermal cracking of silane on Si(111) proceeds along two parallel channels, neither of which involves atomic hydrogen as a surface intermediate. Etching of Si(111) by atomic hydrogen gas exhibits a ~ 5% reaction probability at room temperature and may be rate-controlled by the reaction of a loosely bound hydrogen adlayer with surface SiH_x complexes, competing processes of recombination to produce H_2, and bulk solution-diffusion of surface-adsorbed H atoms becoming more important as the temperature is increased.

47251 (PNL-SA–17225) **Theoretical calculations of the nonlinear dielectric function of inhomogeneous thin films.** Risser, S.M.; Ferris, K.F. Pacific Northwest Lab., Richland, WA (USA). Nov 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-891119–137: Materials Research Society fall meeting, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE90017186. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The dielectric function of inhomogeneous materials is composed of linear and nonlinear responses which are sensitive to the film microstructure as well as the intrinsic properties of the materials. We have developed a method to self-consistently determine the linear and non-linear contributions to the dielectric function of films with random microstructure. This method is based upon a numerical solution of the general electrostatic equations and is applicable to arbitrary shapes and orientations of model defects. This method provides near exact solutions to the linear response of the dielectric function. We have shown that the nonlinear part of the dielectric function is extremely sensitive to the void shape and void fraction.

47252 (PNL-SA–18059) **Optical properties of inorganic polymers.** Ferris, K.F.; Risser, S.M. Pacific Northwest Lab., Richland, WA (USA). Nov 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-891119–139: Materials Research Society fall meeting, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE90017143. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The electronic structure of organic and inorganic polymeric systems are well described by their molecular symmetry, even with the large bond polarity shown by such systems as polyphosphazenes. We have performed calculations using semi-empirical Hamiltonians to determine the electronic structure and optical nonlinearities for a series of model phosphonitrilic and organic compounds. The optical transition energies for phosphonitrilic compounds are greater than their organic counterparts as a result of in-plane π' bonding interactions, and are modulated by the electronegativity of the substituent groups on the phosphorus atoms. We report values for the vertical ionization energy and electronic absorption wavelengths, and use molecular orbital contour analysis to show the effects of ligand electronegativity on the π' network. Hyperpolarizabilities were calculated from third order perturbation theory for a series of phosphonitrilic compounds, $(X_2P\text{-}N)_n$, as a function of bond length alternation and ligand substitution. In contrast to organic polyenes, the difference in π orbital energy between phosphorus and nitrogen is critical to determining the onset of saturation and the magnitude of the hyperpolarizability.

47253 (PSI–66) **Complexation of Cu^{2+}, Ni^{2+} and UO_2^{2+} by radiolytic degradation products of bitumen.** Loon, L.R. Van (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Kopajtic, Z. Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). Lab. fuer Werkstoffe und Nukleare Verfahren. May 1990. 39p. Order Number DE90638129. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The radiolytic degradation of bitumen was studied under conditions which reflect those which will exist in the near field of a cementitious radioactive waste repository. The potential complexation capacity of the degradation products was studied and complexation experiments with Cu^{2+}, Ni^{2+} and UO_2^{2+} were performed. In general 1:1 complexes with Cu^{2+}, Ni^{2+} and UO_2^{2+}, with log K values of between 5.7 and 6.0 for Cu^{2+}, 4.2 for Ni^{2+} and 6.1 for UO_2^{2+}, were produced at an ionic strength of 0.1 M. The composition of the bitumen water was analysed by GC-MS and IC. The major proportion of the bitumen degradation products in solution were monocarboxylic acids (acetic acid, formic acid, myric acid, stearic acid ...), dicarboxylic acids (oxalic acid, phthalic acid) and carbonates. The experimentally derived log K data are in good agreement with the literature and suggest that oxalate determines the speciation of Cu^{2+}, Ni^{2+} and UO_2^{2+} in the bitumen water below pH=7. However, under the high pH conditions typical of the near field of a cementitious repository, competition with OH-ligands will be large and oxalate, therefore, will not play a significant role in the

speciation of radionuclides. The main conclusion of the study is that the radiolytic degradation products of bitumen will have no influence on radionuclide speciation in a cementitious near field and, as such, need not to be considered in the appropriate safety assessment models. (author) 12 figs., 11 tabs., 31 refs.

47254 (SAND–90-0593) **PREGO: A simulation code for one-dimensional viscoelastic acoustics.** Segalman, D.J. Sandia National Labs., Albuquerque, NM (USA). Jul 1990. 34p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90014859. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A computer code, PREGO, has been developed to perform calculations for three related problems: reflection of an acoustic wave against a layered viscoelastic medium: (water/medium); transmission of an acoustic wave through such a medium (water/medium/water); and radiation of an acoustic wave through such a medium: (medium/water). This code draws an experience gained in writing and using a predecessor code, IMPEDE, which was devised to calculate the steady state reflection of an acoustic wave impinging on a layered substrate of elastic or viscoelastic materials. That code employed a finite element formulation to discretize the complex-valued, second order ordinary differential equations for monochromatic steady state acoustics. The principles of numerical analysis that underlie PREGO are different and less subject to discretization error than those used in IMPEDE. The formulation used in PREGO is similar to that of higher dimensional boundary integral formulations in that it uses closed form expressions for the complex velocity fields in each layer, given in terms of the velocities at the boundary of that layer. The solutions for each layer are coupled together by requiring that stresses and velocities be continuous across interfaces. 5 refs., 4 figs.

47255 (UCRL–102807) **Diamond turning of optical crystals.** Saito, T.T.; Syn, C.K.; Fuchs, B.A.; Velsko, S.P. Lawrence Livermore National Lab., CA (USA). Mar 1990. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006265–1: Optical fabrication and testing workshop, Monterey, CA (USA), 12-14 Jun 1990). Order Number DE90015909. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Diamond turning (DT) has proven to be a cost effective optical fabrication technique for both aspherical and spherical/flat figures when precise geometrical tolerances are important. We are interested in the DT of crystals for several reasons. DT has been very effective to insure requisite accurate geometrical orientation of optical surfaces to crystalline axes for frequency conversion applications. Also, DT can achieve figure up to the edge of the crystal. Another key DT benefit is enhanced laser damage threshold, which we feel in part is due to the freedom of the surface from polishing impurities. Several important issues for diamond turning optical crystals are the tool wear, associated surface finish, and laser damage properties. We have found that careful selection and control of diamond turning parameters can yield production techniques for crystals previously considered incompatible with diamond turning. 8 refs., 2 tabs.

47256 (UCRL-CR–104544) **The transport properties of activated carbon fibers.** di Vittorio, S.L. (Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Materials Science and Engineering); Dresselhaus, M.S.; Endo, M.; Issi, J.P. Lawrence Livermore National Lab., CA (USA). Jul 1990. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015910. Source: NTIS, PC A03/MF A01 - OSTI.

The transport properties of activated isotropic pitch-based carbon fibers with surface area 1000 m^2/g have been investigated. We report preliminary results on the electrical conductivity, the magnetoresistance, the thermal conductivity and the thermopower of these fibers as a function of temperature. Comparisons are made to transport properties of other disordered carbons. 19 refs., 4 figs.

47257 (Y/DW–1008) **Analysis of aluminum oxide ceramic.** Carpenter, D.A.; Holcombe, C.E. Oak Ridge Y-12 Plant, TN (USA). 29 Aug 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE90016517. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Several aluminum oxide ceramic disks were received from Coors Ceramics for analysis of black spots occuring on some of the disks. The disks were analyzed by x-ray fluorescence, using the x-ray microprobe in the scanning mode, and by x-ray diffraction. The elements (greater than Z=14) observed, listed in order of approximate concentration, were Zr (several percent), Fe, Ca, Ni, and Sr, (minor to trace amounts). X-ray diffraction analysis revealed a major amount of Al_2O_3 (corundum), a minor amount of ZrO_2, and minor unidentified lines. Some of the unidentified lines could be accounted for by $CaAl_2Si_2O_8$ and $BaAl_2Si_2O_8$. There were no significant dif-ferences between the analyses of the rejected disks and those of the acceptable disks.

47258 Calculation of lattice energies and enthalpies of formation of rare-earth pyrosilicates. O'Brien, M.H. (EG & G Idaho, Inc., Idaho Falls (USA)); Akinc, M. *Journal of Solid State Chemistry (USA)*, 84(1): 130-137 (Jan 1990).

The lattice energies of ionic crystals were calculated from a computer summation of the Coulombic interaction energies. The present technique was first applied to simple crystal symmetries, including rock salts, fluorites, and silicates, to establish the reliability of the method. Calculated values for these systems were found to be within 3 to 8% of the accepted values. The lattice energies of several of the light rare-earth (La through Eu) pyrosilicates, $RE_2Si_2O_7$, were calculated by the same procedure. The enthalpies of formation for these crystals were then estimated from the calculated lattice energies by applying the Born-Haber cycle. Both the low temperature tetragonal and the high temperature orthorhombic forms of the pyrosilicates were calculated.

47259 High-temperature healing of lithographically introduced cracks in sapphire. Rodel, J. (California Univ., Berkeley, CA (USA). Dept. of Materials Science and Mineral Engineering); Glaeser, A.M. *Journal of the American Ceramic Society (USA)*, 73(3): 592-601 (Mar 1990).

A new method for producing controlled-geometry, controlled-crystallography, cracklike defects using photolithography has been developed. The method has been applied to sapphire, and used to study crack healing behavior at 1800°C. Effects of crack face and crack perimeter crystallography, crack face microstructure, and impurities on healing behavior have been identified.

47260 Sintering of particulate composites under a uniaxial stress. Rahaman, M.N. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)); DeJonghe, L.C. *Journal of the American Ceramic Society (USA)*, 73(3): 602-606 (Mar 1990). DOE Contract AC03-76SF00098.

This paper reports the sintering of particulate composites consisting of a fine-grained zinc oxide matrix and coarse silicon carbide inclusions investigated at 725° C under a uniaxial stress of ≈ 250 kPa. Data for the densification and creep rates of the composite were compared with those for the unreinforced matrix. The inclusions cause a drastic reduction in the measured densification and creep rates. They have a greater effect on the densification process, however; the ratio of the densification rate to the creep rate of the composite is approximately half that of the unreinforced compact. The factors that cause the reduction in this ratio are present from the very early stage of sintering.

47261 Reverse micelles and microemulsions in near-critical and supercritical fluids. Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)); Fulton, J.L.; Blitz, J.P.; Tingey, J.M. *Journal of Physical Chemistry (USA)*, 94(2): 781-787 (25 Jan 1990). DOE Contract AC06-76RL01830.

Reverse micelle and water-in-oil (w/o) microemulsion phases can be formed in near-critical and supercritical fluids, giving rise to uniquely pressure dependent phase behavior. The solvating power of reverse micelles formed from the surfactant sodium bis(2-ethylhexyl) sulfosuccinate (AOT) in fluids with moderate critical temperatures (e.g., ethane, propane, or xenon) depends largely upon the water-to-surfactant ratio of the micelle phase (W_m), which at large W_m can approach that of bulk water. The maximum water-to-surfactant ratio (W_0), which defines the boundary between a one-phase and a two-phase fluid system (where a second, predominantly aqueous phase exists), is strongly pressure dependent.

The physical size of a reverse micelle in one-phase AOT/H_2O systems at constant W_m has been shown to be nearly independent of the continuous-phase identity and pressure. In contrast, the apparent hydrodynamic size increases dramatically as W_0 is approached due to increased micelle-micelle attractive interactions (e.g., clustering). The maximum reverse micelle size (W_m $\propto$ diameter) increases with pressure for fluids such as ethane and propane, approaching W_m = 40, corresponding to a droplet size of $\sim$ 17 nm. Significant micelle densities are obtained for two phase systems, even at relatively low pressure (< 100 bar). These systems can be used to efficiently extract hydrophilic substances, including proteins, from dilute aqueous solution with substantial selectivity without the need for any chemical change to the system.

47262 **Reduction and cluster growth of palladium in zeolite Y containing transition metal ions. X-ray absorption studies.** Moller, K. (Univ. of New Mexico, Albuquerque (USA)); Bein, T. *Journal of Physical Chemistry (USA),* 94(2): 845-853 (25 Jan 1990). DOE Contract AS05-80ER10742.

The effect of a second transition metal on the reducibility and agglomeration behavior of palladium in zeolite Y is studied by EXAFS spectroscopy. Special attention is given to the potential bonding interactions between both metal constituents that could result in chemical anchoring of the noble metal to the support via the unreduced cocation. Zeolite Y was coexchanged with Fe^{2+} or Co^{3+} and Pd^{2+} and with each ion alone. Dehydration in oxygen atmosphere and reduction with hydrogen was performed at different temperatures up to 623 K. The structure of the samples during various stages of pretreatment and reduction was studied with EXAFS on both absorption edges. Palladium is partially reduced to Pd^0 at room temperature and forms small metal clusters at higher temperatures. Iron is oxydized under oxygen atmosphere and is partially present in the form of iron oxide particles, which are redispersed under reducing conditions. A small enhancement of the reducibility of palladium is observed if iron is present in the zeolite, but neither a chemical anchoring nor an effect on the final agglomeration process of palladium is detected by the presence of iron cations. In contrast, coexchange with cobalt results in a substantially higher dispersion of the Pd(0) phase after high-temperature reduction. Apparently, the change in cation distribution induced by the Co ions influences the reduction process of palladium. When palladium ions are diffused into the zeolite containing aqueous Fe(II) ions, a Pd(0) phase consisting of larger crystallites is formed at room temperature by a redox reaction with Fe(II).

47263 **Small-angle neutron-scattering study of triglyceride solubilization by lecithin micelles: A direct observation of rod-to-sphere transition.** Lin, Tsanglang (National Tsing-Hua Univ., Hsin-Chu (Taiwan)); Chen, Sowhsin; Gabriel, N.E.; Roberts, M.F. *Journal of Physical Chemistry (USA),* 94(2): 855-862 (25 Jan 1990).

The solubilization of tributyrin by rodlike diheptanoylphosphatidylcholine (diheptanoyl-PC) micelles has been studied by small-angle neutron-scattering techniques. A rod to sphere transition is observed from the measured angular distribution of neutron-scattering intensities. The transition is from the rodlike micelle to a globular mixed micelle which has tributyrin molecules at the core surrounded by an outer shell of diheptanoyl-PC molecules. When the molar ratio of tributyrin to diheptanoyl-PC is increased beyond 0.18, all rodlike diheptanoyl-PC micelles are transformed into globular mixed micelles. The size of these globular mixed micelles increases with increasing tributyrin concentration in the simple micelle region up to the solubility limit. The small-angle neutron scattering data were analyzed to obtain the structural parameters of the mixed micelles. It is found that the growth of the mixed micelles does not follow a constant available surface area model or a constant palisade layer thickness model. If the model is modified to include tributyrin molecules at the surface of the mixed micelle, the growth behavior can be explained. For the tributyrin/diheptanoyl-PC molar ratio less than 0.18, rodlike micelles are found to coexist with globular mixed micelles. By fitting the neutron scattering data in the middle Q range, it is possible to determine the size and number density of the mixed micelles in the coexistence region. The results of analyzing the small-angle neutron scattering data in the coexistence region. The results of analyzing the small-angle neutron scattering data in the coexistence region show that some tributyrin molecules are solubilized by the rodlike diheptanoyl-PC micelles and only part of the added tributyrin forms globular micelles.

47264 **Photoionization of alkylphenothiazines in vesicles: Effects of the alkyl chain length and the vesicle surface charge.** Sakaguchi, Masato (Univ. of Houston, TX (USA)); Hu, Ming; Kevan, L. *Journal of Physical Chemistry (USA),* 94(2): 870-874 (25 Jan 1990).

The photoionization of alkylphenothiazine (AP = alkylphenothiazine) in vesicles were observed by electron spin resonance (ESR) and electron spin echo modulation (ESEM) methods. Alkylphenothiazine derivatives including sodium 10-methylphenothiazinesulfonate (C_1PSO_3Na), sodium 10-dodecylphenothiazinesulfonate ($C_{12}PSO_3Na$), sodium 3-(10′-phenothiazinyl)propane-1-sulfonate (PC_3SO_3Na), sodium 6-(10′-phenothiazinyl)hexane-1-sulfonate (PC_6SO_3Na), and sodium 12-(10′-phenothiazinyl)dodecane-1-sulfonate ($PC_{12}SO_3$ Na) were synthesized and used to study the effects of the alkyl chain length, the position of the sulfonate group, and the vesicle surface charge on the photoionization. A single ESR spectrum due to the alkylphenothiazine cation radicals (AP^+) was observed from rapidly frozen AP in dioctadecyldimethylammonium chloride (DODAC) or dihexadecyl phosphate (DHP) vesicles photoirradiated for 10 min with λ > 300 nm. In DODAC vesicles with a positive surface charge, the photoionization yield of $PC_{12}SO_3Na$ with a sulfonate group at the dodecyl chain end is higher than that of $C_{12}PSO_3Na$ with a sulfonate group on the phenothiazine ring. The photoionization yields of AP having the sulfonate group at the alkyl chain end in DODAC vesicles increase with decreasing alkyl chain length. The highest photoionization yield was obtained from PC_3SO_3Na, which has the shortest alkyl chain in this study and has the sulfonate group at the end of the propyl chain. The photoionization yield of AP in DHP vesicles with a negative surface charge was not changed by added alkyl chains or the position of the sulfonate group in AP. The results are discussed in terms of the alkyl chain length, the position of the sulfonate group, and the vesicle surface charge.

47265 **Studies in hydrogen bonding: Modeling of water in crystalline hydrates.** Brink, G. (Univ. of Witwatersrand (South Africa)); Glasser, L. *Journal of Physical Chemistry (USA),* 94(2): 981-984 (25 Jan 1990).

The orientations and symmetries of the water molecules in the crystalline hydrates NaCl x $2H_2O$, NaBr x $2H_2O$, NaI x $2H_2O$ and LiI x $3H_2O$ have been investigated by use of computer modeling of the hydrates. The interatomic pair potential function EPEN/2 (involving exp(−6) plus Coulombic terms) was applied using previously determined parameters for the alkali-metal and halide ions and the water molecule. Rotational orientations, O-H bond lengths, and H-O-H bond angles of the water molecules were adjusted subject to symmetry constraints, using the computer program WMIN, to give structures with minimum energy. The hydrogen bonding in the modeled structures is compared with experimental evidence on the nature of the hydrogen bonding, particularly that given by infrared spectroscopy of the partially deuterated hydrates. Satisfactory agreement is found between experimental and calculated lattice energies, which provides justification for transferring the EPEN/2 parameters among the various ionic and molecular structure types. The enthalpy of formation of NaCl x $2H_2O$ is calculated from this result to be −255.9 kcal/mol (±5%); this value has not heretofore been reported.

47266 **A new model for pressure-induced shifts of electronic absorption bands as applied to neat CS_2 and CS_2 in n-hexane and dichloromethane solutions.** Agnew, S.F. (Los Alamos National Lab., NM (USA)); Swanson, B.I. *Journal of Physical Chemistry (USA),* 94(2): 995-1002 (25 Jan 1990).

The authors propose a model for the pressure dependence of electronic absorption spectra and apply it to the authors data on CS_2 both in neat phase and in hexane and dichloromethane solid solutions. They believe that their data represent a rather severe test of this model and argue that any model for the pressure dependence of electronic absorption spectra must include certain minimal effects - dispersive or dielectric and repulsive or volume effects - in order to adequately represent the data. They discuss previous models at some length in order to delineate the limits of

their applicability. They further acknowledge and define the limits of the applicability of their model to solvent-induced shifts in general.

47267 **Measuring electrode assembly.** Bordenick, J.E. To Dept. of Energy, Washington, DC (USA). USA Patent 4,814,058/A/. 21 Mar 1989. Filed date 26 Apr 1988. USA Patent Application 7-186,419. Int. Cl. G01N 27/30. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a pH measuring electrode assembly for immersion in a solution. It includes an enclosed cylindrical member having an aperture at a lower end thereof. An electrolyte is located in the cylindrical member above the level of the aperture and an electrode is disposed in this electrolyte. A ring formed of an ion porous material is mounted relative to the cylindrical member so that a portion of this ring is rotatable relative to and is covering the aperture in the cylindrical member. A suitable mechanism is also provided for indicating which one of a plurality of portions of the ring is covering the aperture and to keep track of which portions of the ring have already been used and become clogged.

47268 **Membrane reference electrode.** Redey, L.; Bloom, I.D. To Dept. of Energy, Washington, DC (USA). USA Patent 4,814,062/A/. 21 Mar 1989. Filed date 25 Jan 1988. USA Patent Application 7-147,825. Int. Cl. G01N 27/36. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a reference electrode. It utilizes a small thin, flat membrane of a highly conductive glass placed on a small diameter insulator tube having a reference material inside in contact with an internal voltage lead. When the sensor is placed in a non-aqueous ionic electrolytic solution, the concentration difference across the glass membrane generates a low voltage signal in precise relationship to the concentration of the species to be measured with high spatial resolution.

47269 **Multilayer optical dielectric coating.** Emmett, J.L. To Dept. of Energy, Washington, DC (USA). USA Patent 4,925,259/A/. 15 May 1990. Filed date 20 Oct 1989. USA Patent Application 7-260,429. Int. Cl. G02B 5/26. 14p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a highly damage resistant, multilayer, optical reflective coating that includes alternating layers of doped and undoped dielectric material. The doping levels are low enough that there are no distinct interfaces between the doped and undoped layers so that the coating has properties nearly identical to the undoped material. The coating is fabricated at high temperature with plasma-assisted chemical vapor deposition techniques to eliminate defects, reduce energy-absorption sites, and maintained proper chemical stoichiometry. A number of differently-doped layer pairs, each layer having a thickness equal to one-quarter of a predetermined wavelength in the material are combined to forma narrowband reflective coating for a predetermined wavelength. Broadband reflectors are made by using a number of narrowband reflectors, each covering a portion of the broadband.

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47270 (CNIC–00226) **Precision determination of uranium in uranium oxide by constant-current coulometry.** Xu Laili (Ministry of Nuclear Industry, Beijing, BJ (China). Research Inst. of Uranium Ore Processing); Wang Chunhuan. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 6p. (In Chinese). (BRIUOP–0010). Order Number DE90638017. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A method of constant-current coulometric titration for determination of uranium in uranium oxide is described. The method involves using Cr(II) as reductant to reduce U(VI) to U(IV) in H_2SO_4-H_3PO_4 medium, oxidizing the excess Cr(II) in air, adding the amount of solid $K_2Cr_2O_7$ slightly larger than that required for quantitative oxidation of U(IV) and titrating the excess $K_2Cr_2O_7$ with the electrogenerated Fe(II). The endpoint is determined amperometrically and the reduction-oxidation process was determined. The precision of the method indicated by the standard deviation of an individual observation is better than 0.01% for 1 g uranium oxide.

47271 (CNIC–00240) **Spectrophometric determination of total chromium and hexavalent chromium in waste water from the uranium mining and hydrometallurgical mill.** Cao Xishou (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Li Guizhen. China Nuclear Information Centre, Beijing, BJ (China). 1988. 7p. (In Chinese). (IAE–0052). Order Number DE90638018. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Hexavalent chromium is determined by reaction with diphenylcarbazid in acid condition, and a red violet color compound is produced, which has peak absorbency at 549 nm. If total chromium to be determined, it will be necessary to oxidize the trivalent chromium to Cr(VI) by potassium permanganate before reacting with diphenylcarbazide. The concentration of Ca(II), Mg(II), SO_4^{2-}, NO_3^- and NH_4^+ up to 500 mg/L, and the concentration of As(V), Pb(II), Hg(II), Al(III), Cu(II), Fe(III), Mn(II), Si(IV) and F^- up to mg/mL can be tolerated. The range of chromium from 0.02 ≈ 0.2 mg/mL can be determined. The precision of the method is ± 5%. The recovery of addition standard sample is 95 ≈ 105%.

47272 (CNIC–00241) **Determination of 25 trace impurity elements in U_3O_8 by horizontal ICP-AES after separation with TBP levextrel resin chromatography.** Guan Jingsu (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Shi Youqing; Gao Binghua; Liu Yingmei. China Nuclear Information Centre, Beijing, BJ (China). 1988. 13p. (In Chinese). (IAE–0053). Order Number DE90638019. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A method for the determination of Al, As, Ba, Be, Bi, Ca, Cd, Cu, Co, Cr, Fe, Mg, Mn, Mo, Ni, P, Pb, Ru, Sb, Sn, Sr, Ti, V, W and Zn 25 trace elements in U_3O_8 is reported. The sample is dissolved in HNO_3 or HNO_3-$HCLO_4$-HF and the uranium is separated by TBP Levextrel resin chromatogyaphy. The impurity elements containing in the aquaous phase are determined by horizontal ICp-AES method. With a sample of 300 mg, the detection limit for all the 25 elements is in the range of 0.01≈5ppm, the recovery is in the range of 82≈ 121%, the determination precision (RSD) is less than ±13%. 18 trace elements in reference material of U_3O_8 prepared in China are determined, the values obtained well with the values of overall median of accepted laboratory means.

47273 (CNIC–00243) **Laser-time resolved fluorimetric determination of trace of boron in U_3O_8.** Xu Yongyuan (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Wang Yulong; Wang Qin. China Nuclear Information Centre, Beijing, BJ (China). 1988. 6p. (In Chinese). (IAE–0055). Order Number DE90637992. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

In this work, a laser-time resolved fluorimetric determinatin of trace of boron in U_3O_8 had been developed. The boron complex with dibenzoyl methane (DBM) in a suitable medium is excited by a small nitrogen laser and emits the delay fluorescence with lifetime of 2 ms which is much longer than that of the fluorescence of uranium. Since the fluorescence of uranium doesn't interfere with determination of boron in the time resolved fluorimetric method boron need not be separated from uranium in advance. Thus the determination is very rapid and simple. The limit of determination is 0.02 ngB/ml. When 10 mgU is taken, 0.01 ppm of boron in uranium can be determined. Several samples of U_3O_8 with boron content from 0.04 to 0.5 ppm have been determined by using this method. The results of determination have been accordant with other methods.

47274 (DOE/ER/13946–1) **Design and synthesis of reactive separation systems: Progress report, July 1, 1988–June 30, 1990.** Doherty, M.F. Massachusetts Univ., Amherst, MA (USA). Dept. of Chemical Engineering. Mar 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER13946. Order Number DE90016731. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Separation with chemical reaction is an area of growing importance. Combined reactor-separator systems offer certain advantages which cannot be matched by conventional processing, e.g., the suppression of unwanted by-products, and freedom from some of the restrictions imposed by equilibrium reactions. Chemical reactions can have a startling effect on the behavior of multicomponent separation systems. Under certain conditions, chemical reactions can induce the formation of azeotropes in ideal mixtures (thus hindering the separation), while in nonideal mixtures, chemical reactions can make azeotropes disappear (thus enhancing the separation). A general framework has been developed for anticipating these various possibilities, which makes it possible to determine, in advance, whether a chemical reaction if beneficial or not. Design and synthesis techniques for multicomponent reactive distillations are currently being developed. 2 refs., 8 figs.

47275 (INT–205/I) **Application of scattered primary radiation in X-ray fluorescence analysis.** Markowicz, A. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1986. 30p. (In Polish). Order Number DE90639255. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The recent applications of scattered radiation in X-ray fluorescence analysis are reviewed. The scattered radiation methods based on measurements both of the coherent and incoherent scatter peaks can be applied for a correction of the absorption matrix effect, evaluation of background in X-ray spectra and determination of mass per unit area of the samples to be analysed. The use of the scattered primary radiation enables one to analyse samples of intermediate thickness by XRF method; this extends considerably the practical application of the analytical techniques. A theoretical evaluation of the potentialities as well as the limits of the applicability of the relative scattered radiation method has also been given. 35 refs., 4 figs. (author).

47276 (IPEN-PUB–168) **TBP determination in nitric acid solutions from solvent extraction process.** Kuada, T.A.; Carvalho, E.I. de; Araujo, I. da C.; Cohen, V.H. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 11p. (In Portuguese). Order Number DE90639361. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Heavy organic phases have been observed on some occasions during TBP extraction process. These products, described as red oils, were considered as the main cause for process failures, specially in evaporators and concentrators. In view of safety aspects it is necessary to control organic concentration in product and waste solutions. The proposed method involves the organic removal by chloroform as a first step, followed by purification onto a silica gel column. The results are given from analysing TBP and its degradation product (DBP) by gas chromatography. (author).

47277 (IS-T–1484) **Development, characterization, and applications of optical pH sensors supported at cellulosic film.** Jones, T.P. Ames Lab., IA (USA). 9 Aug 1990. 152p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90016416. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Sensors for the determination of pH have been developed which are based on the immobilization of direct dyes at hydrolyzed cellulosic films. The performance and structural characteristics of the sensors were investigated by a variety of spectroscopic methods, and applications for remote sensing were developed. Films of cellulose acetate were base hydrolyzed in 0.07 M KOH to yield a porous support structure. The structural changes resulting from the hydrolysis on cellulose acetate were probed with infrared internal reflectance spectroscopy. The progress of the hydrolysis reaction was monitored by the changes in vibrational modes of the acetyl group, and other spectral changes indicated changes in film thickness as a result of solvent incorporation. Direct dyes, including Congo Red and C. I. Direct Blue 8, were then immobilized at these porous cellulosic films. The optical response characteristics of the Congo Red pH sensor were characterized, including the UV-visible absorption spectra as a function of pH, the response time as a function of ionic strength and ionic size of electrolyte, the long-term stability of the sensor, the effects of metal-ion interference, and the concentration of Congo Red in the polymer film. The structural characteristics of the sensor were investigated by internal reflectance spectroscopy and resonance-enhanced Raman spectroscopy, and the protonation sites were identified as the two azo groups of Congo Red. Infrared internal reflection spectra of immobilized Congo Red led to the development of a sensor for pH based on infrared spectroscopy. Finally, a two-wavelength fiber-optic photometer, which is based on solid-state sources and detectors, and a fiber-optic photometer, which is based on solid-state sources and detectors, and a fiber-optic probe were developed for pH determinations using Congo Red and C. I. Direct Blue 8 pH sensors.

47278 (IS-T–1485) **Chemical functionalities of carbon in activated carbon; A study by proton NMR, high resolution solid state NMR of ^{13}C and FTIR.** Wang, G.A. Iowa State Univ. of Science and Technology, Ames, IA (USA). 22 Aug 1990. 42p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90016414. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Static solid state proton NMR and Magic Angle Spin (MAS) high resolution ^{13}C NMR were performed on original and oxidized activated carbon. The ^{13}C NMR spectra indicate that there is a relatively narrow dispersion of chemical shifts centered at an isotropic value of 119.5 ppm. The asymmetric shielding components indicate that the majority of the carbon atoms in activated carbon are sp^2 hybridized. The ^1H NMR spectra show that: (a) the mole ratio of H/C in evacuated, " as received" samples is 1:29, (b) most of the protons chemically bound to the carbon are aromatic with the fraction of aliphatic proton being 4.57%. Approximately 0.2 mmole/g of water is chemisorbed on original evacuated sample. 38 refs., 17 figs.

47279 (JINR–18-89-137) **Determination of vanadium content in coals.** Gehrbish, Sh.; Kucher, A.M.; Leonard, M.; Teterev, Yu.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1989. 7p. (In Russian). Order Number DE90639256. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A cyclic neutron activation analysis (CNAA) method for determining the vanadium content in Mongolian coals and phosphorites is described. Samples were irradiated using and experimental setup based on a Sb-Be neutron source. The choice of optimal conditions for CNAA using a ^{124}Sb source with an activity of 2.5×10^{12} Bq allowed one to reach the detection limit of vanadium in coals of 5-10 ppm. The density of the thermal neutron flux in the central channel of the setup was 2×10^6 neutr.xcm^{2}s^{-1}, and that of epithermal neutrons was 2×10^5 neutr.xcm^{2}s^{-1}. 7 refs.; 4 figs.; 2 tabs.

47280 (PB–90-246141/XAB) **Rapid on-site methods of chemical analysis.** Remeta, D.P.; Gruenfeld, M.; Montgomery, R.E. IT Corp., Edison, NJ (USA). ©1985. 60p. Contract EPA-68-03-3069. Source: NTIS, PC A04/MF A01.

Pub. in Contaminated Land - Reclamation and Treatment Chapter 11, 257-309. Library of Congress catalog card No. 85-3562.

The analysis of potentially hazardous air, water and soil samples collected and shipped to service laboratories off-site is time consuming and expensive. The Chapter addresses the practical alternative of performing the requisite analytical services on-site. The most significant application of such methodology is the initial appraisal of chemical waste sites and identification of highly contaminated areas. Hence, the majority of the methods reviewed are selective for classes of compounds, providing semi-quantitative and semi-qualitative information. The methods are useful as screening techniques for monitoring the general levels of contamination in a specific area. The major advantages of field-oriented chemical analysis methods are real time sample analyses and reduced costs. Since field methods are less intricate than conventional methodology, sample throughput is increased substantially, resulting in cost savings. Costs are further reduced through the use of portable instruments that are relatively inexpensive to operate and maintain. The use of rapid on-site methodology does not preclude further characterization of samples for the presence of specific toxicants. In this regard, field methods may assist in identifying certain key analytical parameters which are then examined at a laboratory facility equipped with the appropriate instrumentation. The use of mobile analytical laboratories may be a practical alternative in certain situations.

47281 (PB–90-247362/XAB) **X-ray-absorption spectroscopic investigation of alkali and alkaline earth catalysts in coal gasification. Final report, January 1987-September 1989.** Huggins, F.E.; Shah, N.; Huffman, G.P. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. Apr 1990. 49p. Contract GRI-5086-260-1627. Source: NTIS, PC A03/MF A01.

See also PB–87-215729.

The structures of alkali and alkaline-earth metal catalyst species in lignite and polymer chars and during pyrolysis pretreatment and char gasification have been investigated using ambient and newly-developed, in situ XAFS spectroscopic techniques. The XAFS data, which were obtained at the Stanford Synchrotron Radiation Laboratory, were supplemented by char characterization and reactivity measurements made at the Pennsylvania State University. The findings of the investigation are as follows: (i) the catalytic species, as introduced to the char or lignite, is an atomically-dispersed, metal-ion-oxygen-anion complex, and remains a metal-oxygen complex throughout pyrolysis and gasification; (ii) the catalyst species transforms to a bulk oxide species during pyrolysis pretreatment; (iii) during gasification, the catalyst species rapidly transforms to bulk alkali carbonate in the case of the alkali-metal species and slowly to calcium oxide in the case of the calcium species; (iv) higher catalyst loadings results in an increased number of catalytic sites, rather than any structural variation of the catalyst site due to concentration effects; and (v) reaction of alkali with aluminosilicates (from clays) or silica is the major catalyst poisoning reaction, unless the coal is demineralized in which case the alkali may react with residual halide from HCl or HF used to clean the coal. Such poisoning reactions were not demonstrated for calcium-oxygen species.

47282 (PINSTECH/RIAD–118) **Mass spectrometric analysis of stable carbon isotopes in abiogenic and biogenic natural compounds.** Sajjad, M.I.; Ahmed, M.; Tasneem, M.A.; Khan, I.A.; Latif, Z. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Radiation and Isotope Application Div. Jul 1989. 22p. Order Number DE90639257. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This report describes the general methodology of sup/13/carbon analysis on mass spectrometer and various preparation systems developed for conversion of samples into isotopically non-fractionated and purified carbon dioxide. Laboratory standards required for sup/13/C analysis have been calibrated against international standards. The reproducibility/accuracy of sample preparation and analysis on mass spectrometer for sup/13/C or sup/12/C measurement is well within the internationally acceptable limits. (author).

47283 (SAND–90-2060C) **Infrared absorption in boron carbides: Dependence on isotope and carbon concentration.** Stein, H.; Aselage, T.; Emin, D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900870–4: 10. international symposium on boron, borides and related compounds, Albuquerque, NM (USA), 27-30 Aug 1990). Order Number DE90017592. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Infrared reflectance and transmittance measurements between 500 and 1800 cm^{-1} were obtained on boron carbides with between 10 and 20 atomic percent carbon. Measurements on both boron and carbon isotopically enriched samples indicate that all prominent modes involve boron motion, and that all but a mode near 950 cm^{-1} involve carbon motion. Since the spectrum remains qualitatively unaltered as a function of carbon concentration, its prominent features must have a common structural origin. 5 refs., 4 figs., 2 tabs.

47284 (UM-P–89/99) **Atomic profile imaging of ceramic oxide surfaces.** Bursill, L.A. (Melbourne Univ., Parkville (Australia). School of Physics); Peng JuLin; Sellar, J.R. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 40p. Order Number DE90639538. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Atomic surface profile imaging is an electron optical technique capable of revealing directly the surface crystallography of ceramic oxides. Use of an image-intensifier with a TV camera allows fluctuations in surface morphology and surface reactivity to be recorded and analyzed using digitized image data. This paper reviews aspects of the electron optical techniques, including interpretations based upon computer-simulation image-matching techniques. An extensive range of applications is then presented for ceramic oxides of commercial interest for advanced materials applications: including uranium oxide (UO_2); magnesium and nickel oxide (MgO,NiO); ceramic superconductor ($YBa_2Cu_3O_{6.7}$); barium titanate ($BaTiO_3$); sapphire (α-$A1_2O_3$); haematite (α-Fe-$2O_3$); monoclinic, tetragonal and cubic monocrystalline forms of zirconia (ZrO_2), lead zirconium titanate (PZT + 6 mol.% $NiNbO_3$) and ZBLAN fluoride glass. Atomic scale detail has been obtained of local structures such as steps associated with vicinal surfaces, facetting parallel to stable low energy crystallographic planes, monolayer formation on certain facets, relaxation and reconstructions, oriented overgrowth of lower oxides, chemical decomposition of complex oxides into component oxides, as well as amorphous coatings. This remarkable variety of observed surface stabilization mechanisms is discussed in terms of novel double-layer electrostatic depolarization mechanisms, as well as classical concepts of the physics and chemistry of surfaces (ionization and affinity energies and work function). 46 refs., 16 figs.

47285 Resonance ionization spectroscopy and its potential application in geosciences. Willis, R.D. (Atom Sciences, Inc., Oak Ridge, TN (US)); Thonnard, N.; Cole, D.R. pp. 117-128 of New frontiers in stable isotopic research: Probes, ion probes, and small-sample analysis. Shanks, W.C.; Criss, R.E. US Geological Survey, Denver, CO (USA) (1988). (CONF-8801176–: New frontiers in stable isotopic research: laser probes, ion probes, and small sample analysis, Reston, VA (USA), 12-13 Jan 1988).

This paper discusses resonance ionization spectroscopy (RIS) which provides the basis for several new analytical techniques that have potential in the geosciences. The RIS-based methods feature high sensitivity (parts-per- million to parts-per-trillion range), elemental selectivity (10^3 to 10^9), and generality (applicable to all elements except helium and neon). The authors discuss the RIS process and describe the application of RIS to the analysis of chemically processed samples, noble-gas samples, and to in situ analysis of solids. Applications of RIS in the geosciences include quantitative major, minor, and trace analysis, isotopic analysis, microprobe and depth-profiling analysis, and ultrasensitive noble-gas analysis.

47286 Thermoluminescence dating of a 50,000-year-old human occupation site in northern Australia. Roberts, R.G. (Wollongong Univ. (Australia)); Jones, R.; Smith, M.A. *Nature (London) (UK)*, 345(6271): 153-156 (10 May 1990).

The oldest secure date for human occupation in Greater Australia is 40 kyr from eastern Papua New Guinea, whereas slightly younger dates have been reported from southern Australia. We now report thermoluminescence (TL) dates that suggest the arrival of people between 50 and 60 kyr in northern Australia. TL dates were obtained from sandy footslope deposits at two former occupation sites that yielded a range of stone artefacts in their primary depositional setting. Artefacts terminated mid-way down one profile, which had a basal age of about 100 kyr. Confidence in the TL dates is given by their close correspondence with radiocarbon dates obtained from the upper occupation levels. These TL dates are not only the oldest yet proposed for Aboriginal occupation but also may mark the time of initial human arrival on the Australian continent. (author).

47287 Method for extracting copper, silver and related metals. Moyer, B.A.; McDowell, W.J. To Dept. of Energy, Washington, DC (USA). USA Patent 4,927,610/A/. 22 May 1990. Filed date 1 Jul 1988. USA Patent Application 7-214,814. Int. Cl. B01D 11/00. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a process for selectively extracting precious metal such as silver and gold concurrent with copper extraction from aqueous solutions containing the same. The process utilizes tetrathiamacrocycles and high molecular weight organic acids that exhibit a synergistic relationship when complexing with certain metal ions thereby removing them from ore leach solutions.

47288 Apparatus and method for the spectrochemical analysis of liquids using the laser spark. Cremers, D.A.; Radziemski, L.J.; Loree, T.R. To Dept. of Energy, Washington, DC (USA). USA Patent 4,925,307/A/. 15 May 1990. Filed date 1 May 1984. USA Patent Application 6-606,037. Int. Cl. G01J 3/00. 14p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method and apparatus for the qualitative and quantitative spectroscopic investigation of elements present in a liquid sample using the laser spark. A series of temporally closely spaced spark pairs is induced in the liquid sample utilizing pulsed electromagnetic radiation from a pair of lasers. The light pulses are not significantly absorbed by the sample so that the sparks occur inside of the liquid. The emitted light from the breakdown events is spectrally and temporally resolved, and the time period between the two laser pulses in each spark pair is adjusted to maximize the signal-to-noise ratio of the emitted signals. In comparison with the single pulse technique, a substantial reduction in the limits of detectability for many elements has been demonstrated. Narrowing of spectral features results in improved discrimination against interfering species.

47289 Extractant composition. Smith, B.F.; Jarvinen, G.D.; Ryan, R.R. To Dept. of Energy, Washington, DC (USA). USA Patent 4,923,630/A/. 8 May 1990. Filed date 3 Apr 1989. USA Patent Application 7-331,775. Int. Cl. C09K 3/00. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an organic extracting solution useful for separating elements of the actinide series of the periodic table from elements of the lanthanide series, where both are in trivalent form. It comprises: primary ligand and a secondary ligand, preferably in an organic solvent. The primary ligand is a substituted monothio-1,3-dicarbonyl, which includes a substituted 4-acyl-2-pyrazolin-5-thione, such as 4-benzoly-2,4-dihydro-5-methyl-2-phenyl-3H-pyrazol-3-thione (BMPPT). The secondary ligand is a substituted phosphine oxide, such as trioctylphosphine oxide (TOPO).

47290 Removal of metal ions from aqueous solution. Jackson, P.J.; Delhaize, E.; Robinson, N.J.; Unkefer, C.J.; Furlong, C. To Dept. of Energy, Washington, DC (USA). USA Patent 4,909,944/A/. 20 Mar 1990. Filed date 26 Aug 1988. USA Patent Application 7-237,263. Int. Cl. C02F 1/42. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method of removing heavy metals from aqueous solution, a composition of matter used in effecting the removal, and apparatus used in effecting the removal. One or more of the polypeptides, poly (γ-glutamylcysteinyl)glycines, is immobilized on an inert material in particulate form. Upon contact with an aqueous solution containing heavy metals, the polypeptides sequester the metals, removing them from the solution. There is selectivity of poly (γ-glutamylcysteinyl)glycines having a particular number of monomer repeat units for particular metals. The polypeptides are easily regenerated by contact with a small amount of an organic acid, so that they can be used again to remove heavy metals from solution. This also results in the removal of the metals from the column in a concentrated form.

47291 Photon Calorimeter. Chow, T.S. To Dept. of Energy, Washington, DC (USA). USA Patent 4,848,922/A/. 18 Jul 1989. Filed date 22 Apr 1988. USA Patent Application 7-185,007. Int. Cl. G01K 17/00. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

A photon calorimeter is presented. It comprises a laminar substrate that is uniform in density and homogeneous in atomic composition. A plasma-sprayed coating that is generally uniform in density and homogeneous in atomic composition within the proximity of planes that are parallel to the surfaces of the substrate, is applied to either one or both sides of the laminar substrate. The plasma-sprayed coatings may be very efficiently spectrally tailored in atomic number. Thermocouple measuring junctions are positioned within the plasma-sprayed coatings. The calorimeter is rugged, inexpensive, and equilibrates in temperature very rapidly.

47292 Method for the substantial reduction of quenching effects in luminescence spectrometry. Demas, J.N.; Jones, W.M.; Keller, R.A. To Dept. of Energy, Washington, DC (USA). USA Patent 4,845,368/A/. 4 Jul 1989. Filed date 26 Jan 1987. USA Patent Application 7-068,005. Int. Cl. G01T 1/204. 12p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method for reducing quenching effects in analytical luminescence measurements. Two embodiments of the present invention are described which relate to a form of time resolution based on the amplitudes and phase shifts of modulated emission signal is substantially independent of sample quenching at sufficiently high frequencies. In the second embodiment, the modulated amplitude and the phase shift between the emission signal and the excitation source are simultaneously measured. Using either method, the observed modulated amplitude may reduced to its unquenched value.

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Refer also to citation(s) 46358, 46371, 46373, 46375, 46376, 46383, 46578, 46616, 46639, 46642, 47136, 47138, 47141, 47142, 47143, 47144, 47145, 47147, 47148, 47149, 47150, 47151, 47152, 47153, 47154, 47155, 47156, 47157, 47158, 47160, 47161, 47162, 47163, 47165, 47166, 47169, 47170, 47176, 47183, 47199, 47200, 47202, 47204, 47205, 47206, 47207, 47208, 47209, 47210, 47211, 47215, 47216, 47226, 47227, 47237, 47238, 47240, 47241, 47242, 47243, 47244, 47245, 47246, 47247, 47250, 47261, 47262, 47263, 47265, 47266, 47277, 47278, 47289, 47359, 47360, 47389, 47430, 47481, 47743, 47789, 47928, 47938, 48037, 48045, 48047, 48067, 48068

47293 (DOE/ER/13406–5) **Organometallic chemistry of bimetallic compounds: Progress report.** Casey, C.P. Wisconsin Univ., Madison, WI (USA). Aug 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER13406. Order Number DE90017601. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report briefly discusses past work on heterobimetallic dihydrides, early-late transition metal heterobimetallic compounds, and diphosphine chelates with natural bite angles near 120°. (JDL)

47294 (LBL–26455, pp. 6) **Characterization of microstructures in recording head materials.** Huynh, T.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Polycrystalline $Ba_2(Cu_{0.8}Zn_{1.2})Fe_{12}O_{22}$ for high-frequency VTR heads exhibits large anisotropy and high permeability on its c-planes at high frequencies. The ferrite grains have been magnetically oriented during processing. Characterization of grain-boundary structures with transmission electron microscopy (TEM) and analytical electron microscopy (AEM) has shown that some triple grain junctions have a high concentration of Cu. Ba-deficient second-phase particles have been observed and characterized by convergent-beam electron diffraction (CBED). Twins and dislocations have also been observed. The effects of the microstructural defects on the magnetic properties of the materials could not be studied using Lorentz electron microscopy, as domains could not be imaged, suggesting that this material behaves as a single-domain particle.

47295 (LBL–26455, pp. 15) **National Center for Electron Microscopy.** Thomas, G.; Gronsky, R.; Westmacott, K.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The National Center for Electron Microscopy (NCEM) provides advanced facilities for electron-optical characterization of materials. Its resident staff operate, maintain, design, and develop equipment and software, making it available to all Center users, and in addition conduct their own forefront research on problems in the materials sciences. Central to NCEM are two unique high-voltage electron microscopes, a 1.5-MeV machine (the High-Voltage Electron Microscope, or HVEM), which is the most powerful in the US and a 1-MeV machine (the Atomic Resolution Microscope, or ARM), which offers the best resolution in the world (better than 1.6 Å). These instruments are backed by feeder microscopes (for specimen screening, preliminary experiments, and complementary

microchemical analysis), by specimen-preparation facilities, and by image-processing and analysis facilities, all within the same building and exclusively dedicated to electron microscopy. Research projects at the Center cover a wide spectrum, including phase-transformation studies in metals, ceramics, and minerals; high-T_c superconductors; semiconductor devices; catalyst and amorphous-metal investigations; and biological medical-science applications.

47296 (LBL–26455, pp. 15-23) **The Berkeley atomic resolution microscope - An update.** Hetherington, C.J.D.; Nelson, E.C.; Westmacott, K.H.; Gronsky, R.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Recent modifications to the JEOL ARM-1000 microscope have markedly enhanced its performance. The point resolution limit at 1,000 kV is confirmed by optical diffractograms down to 1.7 Å, and there are firm indications of contrast transfer down to 1.4 Å. The unique tilting capability of the ARM, ± 40° biaxial tilt over the 800-kV to 1,000-kV range, is preserved at this resolution. This paper presents the measured imaging parameters and results on resolution tests. A striking demonstration of the utility of the high-angle tilting stage is provided by the micrographs in future 1-1. These show atomic-resolution images of the same island of GaAs (deposited on a Si substrate) viewed along two <110> directions separated by a 90° tilt.

47297 (LBL–26455, pp. 26) **Multislice calculations: Slicing and those upper Laue layer interactions.** Kilaas, R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The relationship between the inclusion of upper Laue layer interactions in multislice calculations and the method of subdividing the unit cell has been studied in detail. Four different approaches are compared, and it is shown that two of the methods are capable of producing scattering out of the zeroth-order Laue zone. In order to demonstrate the differences between the methods, calculations were carried out on two distinct systems, BiTe and $MgAl_2O_4$.

47298 (LBL–26455, pp. 28) **A TEM [transmission electron microscopy] study of microstructures associated with solution cleavage in limestone.** Meike, A.; Wenk, H.R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Microstructures associated with clay-filled seams in the Scaglie Rossa limestone from the Umbria-Marche Apennines, Italy, were characterized with high-voltage transmission electron microscopy (TEM) in order to study one of the mechanisms that presently falls under the heading of pressure solution. Only seams that formed after lithification, often called solution or spaced cleavage, were examined. Although some observations supported suggestions that much of the clay in the solution cleavage seam could be authigenic, this report focuses primarily on the limestone microstructures. No evidence of plastic deformation could be observed around the seams with an optical microscope. However, the TEM-resolved dislocations concentrated within limited areas of single grains. Comparisons with experimentally deformed calcite microstructures and with computer simulations of TEM dislocation contrast allowed further interpretation of the character and density of dislocations. Dislocation concentrations were frequently associated with voids and pits. The pits and voids were usually elongate in a calcite dislocation slip plane and were interpreted as dissolution features. These and other observations suggested that selective dissolution of localized dislocation tangles was responsible for solution cleavage formation. Similar microstructures associated with stress-corrosion cracking have been interpreted elsewhere as evidence of plastic-strain-enhanced heterogeneous dissolution. Further interpretations indicated that a solution cleavage surface grows laterally like a fracture tip.

47299 (LBL–26455, pp. 36) **In situ investigation of gas-solid reactions by electron microscopy.** Evans, J.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This work is concerned with microstructural aspects of the reactions between gases and solids that are important in materials science. Of particular interest are the nucleation, growth, epitaxy, and chemical nature of solid products formed from the parent phase. Experimental tools used in this investigation include the environmental cells in the high-voltage transmission electron microscopes at LBL, which permit observation and electron-diffraction studies of reaction products as they are formed. Conventional transmission electron microscopy of cross-sectioned reacted samples is used to obtain additional information on the morphology and chemistry of phases occurring at the reaction front. Auxiliary techniques, such as secondary-ion mass spectroscopy (SIMS), also play a role in this investigation. In 1988 the focus of this investigation has been on the oxidation of III-V compound semiconductor materials, particularly gallium arsenide and indium phosphide. Oxidation is a well-established technique in the processing of silicon, the most widely used semiconductor material; dielectric layers can readily be formed on silicon in this way. This straightforward method of producing dielectric layers has so far eluded the processors of III-V compound semiconductors. Additional work has been performed on the annealing of $YBa_2Cu_3O_{7-\delta}$.

47300 (LBL–26455, pp. 38) **Mean-field theory of long-period superstructures on the fcc lattice.** Kulik, J.; de Fontaine, D. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

An Ising model with long-range competing interactions on the fcc lattice is examined in mean-field theory. The completion of the interaction parameters is characterized by a parameter k, and a phase diagram in the (T,k) plane is presented. Long-period superstructures are obtained as ordered states. Results are compared with the ordered structures observed in Ag_3Mg.

47301 (LBL–26455, pp. 105) **Nuclear magnetic resonance.** Pines, A. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The goals of the nuclear magnetic resonance (NMR) program are the development of novel theory and experiments in magnetic resonance and the demonstration of their application to materials research. Recent techniques developed in the author's laboratory include multiple-quantum spectroscopy, zero-field NMR, iterative maps, double rotation (DOR), and SQUID magnetic resonance. Materials applications include clusters, semiconductors, oxides, liquid crystals, zeolites, and intercalated graphite.

47302 (LBL–26455, pp. 105-106) **Oxygen-17 NMR in solids.** Chmelka, B.; Mueller, K.T.; Samoson, A.; Sun, B.; Wu, Y.; Zwanziger, J.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

It is widely lamented that despite its success with spin-1/2 nuclei such as carbon-13, silicon-29, and phosphorus-31, the popular NMR technique of magic-angle spinning (MAS) is restricted in its application to important quadrupolar nuclei such as oxygen-17, sodium-23, and aluminum-27, due to second-order broadening. Two new techniques, double rotation (DOR) and dynamic-angle spinning (DAS), involving the rotation of a sample around two axes, overcome these problems. Preliminary applications of the techniques include high-resolution NMR of sodium-23, and the observation of distinct oxygen-17 sites in solid oxides. Current work is under way on minerals, zeolites, and high-temperature superconductors.

47303 (LBL–26455, pp. 106) **Berry's phase for spins.** Koenig, M.; Mueller, K.T.; Suter, D.; Zwanziger, J.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

When a quantum system undergoes a cyclic evolution, it accumulates a geometric (Berry's) phase related to the topology of a

density matrix space and the geometry of the trajectory. These effects have been demonstrated by NMR interferometry and echo experiments; they are related to the (Pancharatnam) phases accumulated in a cycle of quantum measurements. Current work involves experiments that demonstrate for the first time the non-Abelian generalization of Berry's phase by transporting a degeneracy in a nonconical circuit. It is exciting that this is related to the notion of incomplete quantum measurement.

47304 (LBL–26455, pp. 107) **Multiple-pulsed NMR and iterative maps.** Cho, H.; Mueller, K.T.; Rosen, M.; Rucker, S.P.; Shaka, A.J.; Shykind, D.N. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Multiple-pulse schemes used in the extended excitation of spin systems are traditionally derived by average Hamiltonian theory and periodic application of a basic cycle. An alternative approach, stable over a wide range of instrument parameters, involves the application of iteractive maps on SO(3). Fixed points of $U_{n+1} = F(U_n)$ are sought, where U are propagators that are then implemented by means of sophisticated pulse programmers and digital phase shifters. Recent applications include Carr-Purcell trains, spin-decoupling, bistable maps, and coherence transfer in two-dimensional spectroscopy.

47305 (LBL–26455, pp. 112) **Synthesis of novel solids.** Stacy, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The general goal of this research is to synthesize advanced materials with novel properties. Current work is directed towards the synthesis and characterization of two classes of materials: high-temperature oxide superconductors and rare-earth transition-metal phosphides. In the area of high-temperature oxide superconductivity, research efforts are focused in three areas: (1) synthesis of superconductors using hydroxide fluxes, (2) investigations of partial substitution of ^{18}O in $YBa_2Cu_3O_7$, and (3) a search for new niobium oxide superconductors (supported through a contract with EPRI). Rare-earth compounds are being investigated because they exhibit cooperative phenomena, including valence fluctuations, heavy-fermion superconductivity, and unusual types of magnetic ordering. New classes of rare-earth transition-metal phosphides that exhibit cooperative phenomena (especially superconductivity) are sought. Several new compounds have been discovered, including $EuNi_5P_3$, which exhibits unusual steps in the magnetization-versus-field curves. Such synthetic studies will lead to numerous new classes of materials with novel magnetic and electronic properties.

47306 (LBL–26455, pp. 112) **Low-temperature synthesis of superconducting $La_{2-x}M_xCuO_4$.** Ham, W.K.; Holland, G.F.; Stacy, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The new superconductors generally have been prepared by reactions of intimate mixtures of the metal oxides, carbonates, oxalates, or nitrates at high temperatures (often up to 1,100°C). Since this synthetic route often leads to impure, inhomogeneous products, there is a clear need to discover new synthetic routes. This group has isolated $La_{2-x}M_xCuO_4$ and $Ba_{1-x}K_xBiO_3$ from fused NaOH/KOH melts at temperatures as low as 300°C. The oxides are dissolved in wet, molten NaOH/KOH. Heating between 300°C and 450°C results in slow loss of water and precipitation of the product. The route is a single-step process that leads to high-T_c superconductors at temperatures much lower than those used in previous synthesis. Because the products are precipitated directly from solution, it is possible to control the stoichiometry precisely, and also the particle size. Single crystals can be grown, as well as thin films.

47307 (LBL–26455, pp. 112) **Partial substitution of ^{18}O in $YBa_2Cu_3O_7$: investigations of inhomogeneities and their effect on T_c.** Ham, W.K.; Keller, S.W.; Michaels, J.N.; Stacy, A.M.; Krillov, D.; Hodul, D.T.; Fleming, R.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The possibility of site-selective substitution of ^{18}O into $YBa_2Cu_3O_7$ has been explored. Samples containing various quantities of ^{18}O were prepared by processing in $^{18}O_2$ at 950°C and 450°C. The samples were characterized by secondary-ion mass spectroscopy (SIMS), temperature-programmed desorption (TPD) and reduction (TPR), Raman spectroscopy, and magnetization measurements. Measurements of the shifts in the Raman active modes with ^{18}O substitution and of the ratios of ^{18}O to ^{16}O by TPD, TPR, and SIMS show that even for temperatures as low as 450°C and times as short as 2 hr, ^{18}O is not substituted exclusively into the chain site (O1) in $YBa_2Cu_3O_7$. This result indicates that other oxygen sites are involved in the mechanism for oxygen diffusion in $YBa_2Cu_3O_7$. In addition, there is no consistent variation in the shifts in T_c with the degree of substitution; therefore, the isotope effect for a sample with 100% ^{18}O substitution cannot be predicted by a linear extrapolation of data obtained for samples with partial ^{18}O substitution. The difficulties of measuring the true isotope shift have been explored.

47308 (LBL–26455, pp. 112-113) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The synthesis of the superconducting oxides $Ba_{1-x}K_xBiO_3$ and $YBa_2Cu_3O_7$ using hydroxide melts is being explored. Large single crystals of $EuNi_5P_3$ are being synthesized for use in neutron-diffraction experiments; these experiments will help elucidate the complex magnetic structure.

47309 (PSI–65) **Colloid chemistry: available sorption models and the question of colloid adhesion.** Grauer, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). May 1990. 141p. (In German). Order Number DE90636476. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

A safety analysis of a radioactive waste repository should consider the possibility of nuclide transport by colloids. This would involve describing the sorption properties of the colloids and their transport in porous and fissured media. This report deals with some aspects of the chemistry of this complex subject. Because the mechanisms of ion adsorption onto surfaces are material-specific, attention should be paid to identifying the material constitution of aquatic colloids. Suitable models already exist for describing reversible adsorption; these models describe sorption using mass action equations. The surface coordination model, developed for hydrous oxide surfaces, allows a uniform approach to be adopted for different classes of materials. This model is also predictive and has been applied successfully to natural systems. From the point of view of nuclide transport by colloids, irreversible sorption represents the most unfavourable situation. There is virtually no information available on the extent of reversibility and on the desorption kinetics of important nuclide/colloid combinations. Experimental investigations are therefore necessary in this respect. The only question considered in connection with colloid transport and its modelling is that of colloid sticking. Natural colloids, and the surfaces of the rock on which they may be collected, generally have negative surface charges so that colloid sticking will be difficult. The DLVO theory contains an approach for calculating the sticking factor from the surface potentials of the solid phases and the ionic strength of the water. However, it has been shown that this theory is inapplicable because of inherent shortcomings which lead to completely unrealistic predictions. The sticking probability of colloids should therefore be determined experimentally for systems which correspond as closely as possible to reality. (author) 66 figs., 12 tabs., 204 refs.

47310 (PSI–74) **On the problem of silica solubility at high pH.** Eikenberg, J. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jul 1990. 57p. Order Number DE90639370. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The aqueous system Na_2O-H_2O-SiO_2 plays an important role when strong alkaline pore waters of a cement-based intermediate level radioactive waste repository intrude into the rock formations surrounding the near field. Under such conditions unknown quantities of silica may dissolve. Therefore the pH-dependence of the

solubility of amorphous silica and quartz is investigated by a parameter variation study using the geochemical speciation code MINEQL/EIR. Published silica solubility data obtained in NaOH solutions at 25 and 90°C are compared with results of four models which use different proposed values of the rather uncertain equilibrium constants. Of main interest is the question of whether, in a high pH region, the silica solubility can be explained with different monomeric species only, or to what extent additional polymeric silica species have to be considered as well. Solubility of amorphous silica at 25°C is well understood up to pH 10.5, where it is determined by the solubility product and the first dissociation constant of monomeric silic acid. The most probable cause of the increased solubility of amorphous silica between pH 10.5 and 11.3 is the formation of dimers, trimers and tetramers. Below a total silica concentration of 0.001 M and pH $\leq$ 10.0, however, polymerisation proves to be insignificant. Besides low temperature studies using amorphous silica, the solubility of quartz has also been measured in NaOH solutions at 90°C. As is the case at lower temperatures, the reported values for the second dissociation constant at 90°C scatter widely. It can be shown that in a NaOH medium up to 0.1 M only mononuclear silica species are stable. Therefore it is concluded that the trend of monomers to form polymers decreases strongly with temperature. In strong NaOH solutions at elevated temperatures, silica-sodium ion pairing seems to gain importance.

47311 (SAND–90-0647C) **Thermochemistry of shock-induced exothermic reactions in selected porous mixtures.** Boslough, M.B. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9008125–4: Explomet conference, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016104. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Steady detonation theory has been used to describe shock-induced chemical reactions in a variety of powder mixtures. By introducing a number of simplifications, pressure and temperature increases caused by a reaction can be estimated by considering only the initial powder density, porosity, heat of reaction and thermophysical properties of the product phases. For a given mixture, the pressure increase is greater for higher initial powder packing density. Materials with large volume increases associated with the reaction will demonstrate the largest pressure increases, as expected. Shock temperatures can be approximated by a linearly increasing function of pressure, where the zero-pressure intercept is the adiabatic reaction temperature and the slope depends on initial porosity, volume change and product specific heat. The approximation provides a means of characterizing shock-induced chemical reactions in terms of zero-pressure material properties. 8 refs., 2 figs., 1 tab.

47312 (UCRL-ID–103345) **Ab initio multireference configuration interaction study of CH_2NNO_2 · HONO elimination vs. NN bond fragmentation.** Mowrey, R.C. (Naval Research Lab., Washington, DC (USA)); Page, M.; Adams, G.F.; Lengsfield, B.H. III. Lawrence Livermore National Lab., CA (USA). Mar 1990. 21p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. Contract N00014-89-WX-24146;Contract N00014-89-WX-24024. Order Number DE90014830. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Features of the potential energy surface pertinent to the thermal decomposition mechanism of methylenenitramine (CH_2NNO_2) are investigated. At issue are the activation energies both for concerted molecular dissociation leading to HCN and HONO and for the simple NN bond cleavage leading to CH_2N and NO_2. We use multiconfiguration (MC)SCF wavefunctions with double-zeta and double-zeta plus polarization quality basis sets to locate minimum energy and transition state structures as well as determine harmonic vibrational frequencies and resulting zero-point vibrational energies. The energetics are determined using configuration interaction wavefunctions which include single and double excitations from a selected set of reference configurations constructed with the MCSCF molecular orbitals. Our best calculations, without adjustment, predict the molecular dissociation to have an activation energy slightly lower than that for simple bond rupture. Calculations at the level of those reported here are known, however, to underestimate bond dissociation energies by several kcal/mol. Based on trends from past calculations, and new calculations on a related compound, we estimate the activation energy for the HONO elimination path to be 31 $\pm$ 4 kcal/mol and the NN bond dissociation energy to be 35 $\pm$ 4 kcal/mol. This reverses the energetic ordering of previous theoretical predictions and is consistent with recent molecular beam experiments. 17 refs., 2 figs., 4 tabs.

47313 **Magnetic isotope effect.** Step, E.N. (AN SSSR, Moscow (USSR). Inst. Khimicheskoj Fiziki); Tarasov, V.F.; Buchachenko, A.L. *Nature (London) (UK)*, 345(6270): 25 (3 May 1990).

Short communication. ISOTOPE EFFECTS/spin; ISOTOPE EFFECTS/sulfur 33; SULFUR 33/isotope effects; HYPERFINE STRUCTURE; SPIN; MAGNETIC MOMENTS; MAGNETIZATION; PHOTOLYSIS

47314 **The syn rotational barrier in butane.** Allinger, N.L. (Univ. of Georgia, Athens (USA)); Grev, R.S.; Yates, B.F.; Schaefer, H.F. III. *Journal of the American Chemical Society (USA)*, 112(1): 114-118 (3 Jan 1990). DOE Contract FG09-87ER13811.

The syn barrier for rotation about the central bond in butane has been determined via ab initio theoretical techniques, with various basis sets up to and including triple-ζ with two sets of polarization functions of carbon, and with varying amounts of electron correlation up to and including the coupled cluster with single and double excitations (CCSD) level of theory. After including zero-point and thermal corrections, these studies give the best available $\Delta H^{\ddagger}_{298}$ value for this quantity at present at 4.89 kcal/mol. Previous theoretically determined syn-anti energy differences that disagreed with spectroscopically and molecular mechanics derived values are shown to be too large because of inadequate basis sets.

47315 **Structural studies on cyclopentadienyl compounds of trivalent cerium: Tetrameric $(MeC_5H_4)_3Ce$ and monomeric $(Me_3SiC_5H_4)_3Ce$ and $[(Me_3Si)_2C_5H_3]_3Ce$ and their coordination chemistry.** Stults, S.D. (Univ. of California, Berkeley (USA)); Andersen, R.A.; Zalkin, A. *Organometallics (USA)*, 9(1): 115-122 (Jan 1990). DOE Contract AC03-76SF00098.

The coordinated tetrahydrofuran in $(MeC_5H_4)_3Ce(THF)$ can be removed by Me_3Al in a Lewis acid-base reaction or by the toluene-reflux method to give base-free $(MeC_5H_4)_3Ce$ which is a monomer in the gas phase though a tetramer in the solid state: monoclinic, $P2_1/a$, with a = 12.497 (5) Å, b = 26.002 (8) Å, c = 9.664 (3) Å, β = 97.33 (3)°; R = 0.041 for 2,117 data, $F^2 > 2\sigma(F^2)$. The structure is made up of a cyclic tetramer in which two MeC_5H_4 rings are η^5-bonded to each cerium atoms and one MeC_5H_4 ring is bridging two cerium atoms such that the MeC_5H_4 ring is η^5-bonded to one cerium and η^1-bonded to the other. With larger cyclopentadienyl groups, the binary metallocenes (η^5-$Me_3SiC_5H_4)_3Ce$, (η^5-$Me_3CC_5H_4)_3Ce$, and $[\eta^5$-$(Me_3Si)_2C_5H_3]_3Ce$ are monomeric in the gas phase and the solid state. The structure of the latter is based upon a trigonal-planar geometry the crystals are monoclinic, I2/c, with a = 22.752 (5) Å, b = 11.386 (3) Å, c = 17.431 (4) Å, β = 105.70 (3)°, R = 0.046 for 2,519 data, and $F^2 > 3\sigma(F^2)$.

47316 **Reactions of $(C_5Me_5)Rh(PMe_3)(R)H$ with electrophiles. Insertion of unsaturated molecules into activated carbon-hydrogen bonds.** Jones, W.D. (Univ. of Rochester, NY (USA)); Chandler, V.L.; Feher, F.J. *Organometallics (USA)*, 9(1): 164-174 (Jan 1990). DOE Contract FG02-86ER13569.

The complexes $(C_5Me_5)Rh(PMe_3)(aryl)H$ (aryl = C_6H_5, 2,6-$C_6H_3Me_2$) are found to react with several electrophiles. Treatment with CS_2 gives two products, the major species resulting from the elimination of benzene and formation of $(C_5Me_5)Rh(PMe_3)(CS_2)$. The minor product is formed by insertion into the Rh-H bond to give $(C_5Me_5)Rh(PMe_3)(Ph)(SCH{=}S)$. Reaction of the aryl hydride complex with PhNCS gives only the insertion product $(C_5Me_5)Rh(PMe_3)(Ph)(SCH{=}NPh)$. These two sulfur-bound derivatives react with either aniline of H_2S, respectively, to give $(C_5Me_5)Rh(PMe_3)(Ph)[SCH(SH)(NHPh)]$, which cleaves during isolation to give $(C_5Me_5)Rh(PMe_3)(Ph)(SH)$ and $PhNHCH{=}S$. Reaction of the aryl hydride complex with dimethyl acetylenedicarboxylate results in insertion of acetylene into the Rh-H bond, producing a mixture of the cis and trans vinyl complexes. HI cleaves the rhodium-aryl bond, and iodine induces both elimination of substituted styrene and iodination of the metal-xylyl bond in the cis complex. Treatment of the trans

isomer with HI also cleaves the Rh-aryl bond, and iodine gives a mixture of products. The methyl complex $(C_5Me_5)Rh(PMe_3)(CH_3)H$ reacts with dimethyl acetylenedicarboxylate to give a mixture of cis and trans vinyl methyl complexes. Addition of iodine results in the formation of methyl iodide and $(C_5Me_5)Rh(PMe_3)[C(COOMe)=CH(COOOMe)]I$. cis-$(C_5Me_5)Rh(PMe_3)(2,6\text{-}C_6H_3Me_2)[C(COOMe)=CH(COOOMe)]$ crystallizes in the triclinic space group $P\bar{1}$ with a = 8.928 (5) Å, b = 19.111 (4) Å, c = 8.590 (2) Å, α = 94.21 (2)°, β = 111.86 (4)°, γ = 94.08 (3)°, V = 1348.9 (1.8) Å^3, and Z = 2.

47317 Cluster complexes containing ynamine ligands. 1. Synthesis and structural characterizations of the complexes $Os_4(CO)_{11}(\mu_3\text{-}MeC_2NMe_2)(\mu\text{-}MeC_2NMe_2)(\mu_3\text{-}S)$, $Os_4(CO)_{11}[\mu\text{-}C(Me)C(NMe_2)C(NMe_2)CMe](\mu_3\text{-}S)$, $Os_4(CO)_{11}[\mu\text{-}C(NMe_2)C(Me)C(Me)C(NMe_2)](\mu_3\text{-}S)$, OAdams, R.D. (Univ. of South Carolina, Columbia (USA)); Chen, Gong; Sun, Sixiu; Tanner, J.T.; Wolfe, T.A. *Organometallics (USA)*, 9(1): 251-260 (Jan 1990).

The reaction of $Os_4(CO)_{12}(\mu_3\text{-}S)$ (1) with MeC_2NMe_2 yielded the complexes $Os_3(CO)_9(\mu_3\text{-}MeC_2NMe_2)(\mu_3\text{-}S)$ (2), $Os_4(CO)_{11}(\mu_3\text{-}MeC_2NMe_2)(\mu\text{-}MeC_2NMe_2)(\mu_3\text{-}S)$ (3), $Os_4(CO)_{11}[\mu\text{-}C(Me)C(NMe_2)C(NMe_2)CMe](\mu_3\text{-}S)$ (4), $Os_4(CO)_{11}[\mu\text{-}C(NMe_2)C(Me)C(Me)C(NMe_2)](\mu_3\text{-}S)$ (5), $Os_4(CO)_9(\mu\text{-}MeC_2NMe_2)[\mu\text{-}C(Me)C(NMe_2)C(Me)C(NMe_2)](\mu_3\text{-}S)$ (6), and $Os_3(CO)_7(\mu_3\text{-}MeC_2NMe_2)(\mu\text{-}MeC_2NMe_2)(\mu_3\text{-}S)$ (7), all in low yields. Compounds 3-7 are new and have been characterized by Ir, ^1H NMR, and single-crystal X-ray diffraction analyses. Compound 3 contains a chain of four osmium atoms with two bridging ynamine ligands and a bridging sulfido ligand. Both ynamine ligands contain strong π-bonding interactions between the NMe_2 groups and the neighboring carbon atom in the alkynyl groups. These interactions alter the metal-carbon bonding, and the ynamine ligands adopt structures that resemble aminocarbene ligands. Similar structures were found for the ynamine ligands in 7. Compounds 4-6 contain spiked triangular clusters of four osmium atoms with a triply bridging sulfido ligand on the triangular grouping. Each of these compounds also contains a metallacyclopentadiene group formed by the coupling of two ynamine ligands. In each compound, the two ynamine ligands have been coupled in a different way. In 4, they were coupled tail to tail. In 5 they were coupled head to head, and in 6 they were coupled head to tail. There is structural evidence for significant, albeit weaker, π-bonding interactions between the amino groups and the adjacent carbon atoms in these complexes. This seems to produce a weakening of the corresponding metal-carbon bonding.

47318 Fluorine-substituted ferracyclopentadiene complexes with an unprecedented fluorine bridge between boron and carbon. Mirkin, C.A. (Pennsylvania State Univ., University Park (USA)); Lu, Kuanglieh; Geoffroy, G.L. *Journal of the American Chemical Society (USA)*, 112(1): 461-462 (3 Jan 1990).

The authors recently reported the preparation of ferracyclopentadiene complexes, which are derivatives of the well-known complex $Fe_2(\mu\text{-}CH_2)(CO)_8$. Pettit has shown that the latter compound readily reacts with alkynes to form binuclear allyl complexes, and it was thus of interest to determine if complex 1 would incorporate alkynes in a similar fashion. However, as reported herein, this reaction takes a most surprising course, to yield fluorine-substituted ferracyclopentadiene complexes that form by fluoride donation from BF_4^- and which have been crystallographically shown to possess an unprecedented fluorine atom bridge between carbon and boron atoms. Furthermore, it has been found that the fluorine substituent is readily abstracted by the BF_3 group when this complex is treated with nucleophiles.

47319 Potential energy surfaces for the Mo + H_2 reaction: Collinear versus perpendicular collisions. Li, Junqing (Arizona State Univ., Tempe (USA)); Balasubramanian, K. *Journal of Physical Chemistry (USA)*, 94(2): 545-552 (25 Jan 1990). DOE Contract FG02-86ER13558.

The potential energy surfaces (PES) of 16 electronic states for the Mo + H_2 reaction are studied in two modes of collisions, namely collinear ($C_{\infty v}$) and perpendicular (C_{2v}) modes, using the complete active space MCSCF (CASSCF) followed by multireference singles + doubles configuration interaction (MRSDCI) method. The effect of spin-orbit coupling on the ground state of MoH_2 is also addressed by use of the relativistic CI (RCI) method. In the insertion mode (C_{2v}), the ^7S ground state of Mo has to surmount a barrier of 89 kcal/mol to insert with H_2 to form the linear $^7\Sigma_g^+$ MoH_2 state, while the b^5D ($4d^55s^1$) state of Mo inserts spontaneously into H_2 to form the bent $^5B_2$ MoH_2 ground state (R_e = 1.67 Å, θ^e = 116°). The other electronic states of Mo such as a ^5S, a ^5D, etc. insert into H_2 with small barriers while a ^3P, a ^3D, and a ^1S states insert into H_2 spontaneously. The $^7A_1$ and $^5B_2$ curves cross at $\theta \sim 35°$ which should provide for a channel for ^7S insertion in the Landau-Zener model. In the collinear ($C_{\infty v}$) mode of collision, the Mo(^7S) atom forms only a weak complex with H_2 while some of the quintet and triplet states form a stronger bond with H_2. Thus Mo reacts in the insertion mode more readily than the collinear mode. Mulliken population analyses and dipole moment analyses reveal considerable ionic character of the Mo-H bonds in MoH_2.

47320 Excitonic interactions in naphthalene clusters. Wessel, J.E. (Aerospace Corp., Los Angeles, CA (USA)); Syage, J.A. *Journal of Physical Chemistry (USA)*, 94(2): 737-747 (25 Jan 1990). DOE Contract FG03-86ER60391.

Well-resolved vibronic spectra, recorded by resonance two-photon ionization, are analyzed for cold naphthalene cluster species. Spectra for isotopically pure tetramers and both pure and mixed isotopic trimer clusters provide information on resonant (excitonlike) interactions. An analysis of the spectra suggests that the tetramer geometry resembles bulk crystalline naphthalene, whereas the trimer structure minimizes direct contact interactions. Cluster geometry is similar in ground and excited states of these clusters and there is no direct evidence for rapid dynamics in the excited states, nor is there evidence of multiple geometric conformations. Analysis of the isotopically mixed trimers suggests a preference for the HDH conformation, rather than HHD. An empirical weak interaction model provides a successful description of the observed spectra. Excitonic splittings are approximately proportional to dipole transition strengths for the vibronically induced spectra, whereas low-intensity allowed origin transitions exhibit splittings that greatly exceed dipolar contributions. Both results indicate that the long-range intermolecular potential exceeds simple estimates. This method of analysis may be applicable to studies of larger clusters, providing new information on size-dependent structure and dynamics.

47321 Spectral shifts in acid-base chemistry. 1. Van der Waals contributions to acceptor numbers. Riddle, F.L. Jr. (Lehigh Univ., Bethlehem, PA (USA)); Fowkes, F.M. *Journal of the American Chemical Society (USA)*, 112(9): 3259-3264 (25 Apr 1990).

The ^{31}P NMR spectra of triethylphosphine oxide (Et_3PO) undergoes a shift upon interaction in solution with adjacent molecules. The oxygen of Et_3PO is a strong electron donor and readily forms acid-base complexes with electron acceptors, with a consequent downfield shift in the ^{31}P NMR spectrum ($\Delta\delta^{ab}$). The authors find that the ^{31}P NMR spectrum also is shifted downfield appreciably by van der Waals (largely dispersion force) interactions with solvents ($\Delta\delta^d$). Mayer and Gutmann used the total ^{31}P NMR spectral shift of Et_3PO upon interaction with test liquids for the assignment of acceptor numbers (AN), however, even basic liquids such as pyridine have large AN values because of the strong van der Waals attractive forces of liquid pyridine. This paper offers a method of correcting AN values for the van der Waals contribution to the chemical shift on the basis of the determination of the γ^d values from measurements of the surface and interfacial tensions of the test liquids.

47322 A six-body potential energy surface for the S_N2 reaction $Cl^-(g) + CH_3Cl(g)$ and a variational transition-state-theory calculation of the rate constant. Tucker, S.C. (Univ. of Minnesota, Minneapolis (USA)); Truhlar, D.G. *Journal of the American Chemical Society (USA)*, 112(9): 3338-3347 (25 Apr 1990).

Correlated calculations (MP2/6-31G**) of the energies and frequencies at the saddle point, ion-dipole complex, and reactants plus additional energy calculations at selected geometries in the strong interaction region are used to parameterize a multidimensional potential energy function for the title reaction. Semiclassical variational transition-state theory is used to calculate the gas-phase

rate coefficient and to determine a semiempirical value of the barrier height to reproduce the experimental value of this coefficient at 300 K. The semiempirical gas-phase barrier height is 3.1 kcal/mol. A new potential energy function with this barrier height is created and used to calculate the temperature-dependent rate coefficients and phenomenological activation energies for both CH_3Cl and CD_3Cl over the 200-1,000 K temperature range. The activation energy is predicted to show a large temperature dependence. The kinetic isotope effect is predicted to be 1.04 at room temperature.

47323 Effect of nonequilibrium solvation on chemical reaction rates. Variational transition-state-theory studies of the microsolvated reaction $Cl^-(H_2O)_n + CH_3Cl$. Tucker, S.C. (Univ. of Minnesota, Minneapolis (USA)); Truhlar, D.G. *Journal of the American Chemical Society (USA),* 112(9): 3347-3361 (25 Apr 1990).

The authors present a potential energy surface for the microhydrated S_N2 reaction of a chloride ion with methyl chloride in the presence of one or two water molecules. All degrees of freedom are included. The authors analyze the stationary points corresponding to reactant, ion-dipole complex, and transition state for the monohydrated and the dihydrated reactions, and they use generalized transition-state theory to evaluate the rate constants for these reactions. A noteworthy feature of the dynamics calculations is that vibrational zero point effects are included, as are effects of quantization on vibrational heat capacities and entropies, and water molecules are treated as nonrigid. The authors find that the rate constant at 300 K decreases from the gas-phase value of 3.5×10^{-14} cm^3 $molecule^{-1}$ s^{-1} to a value of 1.1×10^{-17} cm^3 $molecule^{-1}$ s^{-1} for the monohydrated reaction and to a value of 3.7×10^{-20} cm^3 $molecule^{-1}$ s^{-1} for the dihydrated reaction.

47324 Electronic structure and bonding in four-coordinate organometallic complexes of aluminum. Valence photoelectron spectra of BHT-H, $Me_3Al(PMe_3)$, and $Me_2(BHT)Al(PMe_3)$. Lichtenberger, D.L. (Univ. of Arizona, Tucson (USA)); Hogan, R.H.; Healy, M.D.; Barron, A.R. *Journal of the American Chemical Society (USA),* 112(9): 3369-3374 (25 Apr 1990).

The He I valence photoelectron spectra of the Lewis acid-base adducts $Me_3Al(PMe_3)$ and $Me_2(BHT)Al(PMe_3)$ (BHT–H = 2,6-di-tert-butyl-4-methylphenol) have been obtained to characterize the electronic structure and bonding in four-coordinate organometallic complexes of aluminum. To aid in the assignment of the spectrum of $Me_2(BHT)Al(PMe_3)$, the spectrum of the free alcohol, BHT-H, was also obtained. The first and second ionizations of the free BHT-H alcohol show vibrational progressions associated with the symmetric C-C phenyl ring stretching modes, consistent with the b_1 and a_2 π ionizations, respectively, of monosubstituted phenyl rings. In the photoelectron spectrum of BHT coordinated to aluminum in $Me_2(BHT)Al(PMe_3)$, the corresponding phenoxide a_2 ionization retains the vibrational structure, but the individual vibrational components are lost in the ionization that corresponds most closely with the b_1. The loss of vibrational fine structure associated with ionization from the phenyl π b_1 orbital in the coordinated phenoxide shows that the phenoxide is involved in a π interaction with the $Me_2Al(PMe_3)$ portion of the molecule.

47325 Clusters containing carbene ligands. 7. Preparation of $Os_3(CO)_8[C(H)NMe_2](\mu_3\text{-}S)(\mu\text{-}H)_2$ and the nature of its reactions with secondary and tertiary amines. Adams, R.D. (Univ. of South Carolina, Columbia (USA)); Babin, J.E.; Kim, Hoon Sik; Tanner, J.T.; Wolfe, T.A. *Journal of the American Chemical Society (USA),* 112(9): 3426-3435 (25 Apr 1990).

$Os_3(CO)_9(\mu_3\text{-}CO)(\mu_3\text{-}S)$ and $Os_3(CO)_{10}(\mu\text{-}SPh)(\mu\text{-}H)$ were found to react with NMe_3 to yield the complex $Os_3(CO)_8[C(H)NMe_2](\mu_3\text{-}S)(\mu H)_2$ (1a) in yields of 31% and 26%, respectively. $Os_3(CO)_{10}(\mu CNMe_2)(\mu\text{-}H)$ was found to react with H_2S to yield 1a in 36% yield. Compound 1a was analyzed by a single-crystal X-ray diffraction analysis and was found to contain a secondary (dimethylamino)carbene ligand terminally coordinated to a sulfur-bridged triosmium cluster. 1e was decarbonylated at 145°C to give $Os_3(CO)_7[C(H)N(Et)(CH_2)_2NMe_3](\mu_3\text{-}S)(\mu\text{-}H)_2$ (2e) in 41% yield. Compound 2e was characterized by a single-crystal X-ray diffraction analysis and was found to contain a terminally coordinated $C(H)N(Et)(CH_2)_2NMe_2$ carbene ligand chelated to the cluster through coordination of the NMe_2 group. A mechanism is proposed that involves iminium ligand intermediates that couple to the carbene ligand to form a nitrogen-containing metallacycle.

47326 Addition of methylene chloride and methyl iodide to the phenyl ring of aryl imido/amido complexes of rhodium. Ge, Yuanwen (Univ. of Missouri, Columbia (USA)); Sharp, P.R. *Journal of the American Chemical Society (USA),* 112(9): 3667-3668 (25 Apr 1990). DOE Contract FG02-88ER13880.

Growing interest in late-transition-metal oxo, imido, amido, alkoxo, and aryloxo complexes has resulted in the preparation of a number of complexes in which these ligands are highly basic. The resulting reaction chemistry is dominated by the nucleophilic or basic properties of the heteroatom center. In this communication the authors report a novel and unusual reaction of a late-transition-metal aryl imido/amido complex which indicates that the high electron density at the nitrogen center has been distributed out into the aryl ring, inducing high nucleophilic reactivity at the para ring position.

47327 Ammonia-acetone mixed clusters: Internal ion-molecule reactions, structure, and bonding. Tzeng, W.B. (Pennsylvania State Univ., University Park (USA)); Wei, S.; Neyer, D.W.; Keesee, R.G.; Castleman, A.W. Jr. *Journal of the American Chemical Society (USA),* 112(11): 4097-4104 (23 May 1990).

Internal ion-molecule reactions in mixed ammonia-acetone clusters are studied by use of multiphoton ionization. Some differences in the branching ratios that arise in the clusters produced by using three clustering methods serve to elucidate reaction mechanisms. In experiments involving the coexpansion of the vapors, the ion intensity ratio $[(C_3H_6O)_{m+1}^+]/[(C_3H_6O)_m{\cdot}H^+]$ increases as the ammonia/acetone mixing ratio increases. The result indicates that the unprotonated cluster ions $(C_3H_6O)_{m+1}^+$ result from the ionization of the mixed clusters $(NH_3)_p{\cdot}(C_3H_6O)_q$ and, most importantly, suggests that the keto form of the ion is responsible for photon transfer in this system. In the second method, involving the attachment of acetone to preformed ammonia clusters, the acetone molecules strongly interact with the preformed neat ammonia clusters to form long-lived mixed neutral acetone-molecule clusters $(NH_3)_p{\cdot}(C_3H_6O)_q$. When mixed neutral clusters are formed by the addition of ammonia to preexisting acetone clusters, only small signals of $((NH_3)_n{\cdot}(C_3H_6O)_m)H^+$ ion peaks for n = 1 and m = 1-4 are observed, even at high ammonia flow rates.

47328 Application of the GAPT population analysis to some organic molecules and transition structures. Cioslowski, J. (Florida State Univ., Tallahassee (USA)); Hamilton, T.; Scuseria, G.; Hess, B.A. Jr.; Hu, Jiani; Schaad, L.J.; Dupuis, M. *Journal of the American Chemical Society (USA),* 112(11): 4183-4186 (23 May 1990).

Atomic charges in ozone, carbon monoxide, silylene, silaketene and dimethylsilaketene (for both the pyramidal minimum and the planar transition state), 2-methyl-2-silacyclopropanone, ethylenebromonium cation (open and bridged), (Z)-1,3-butadiene, 1,3-cyclopentadiene, cyclopropene, methylenecyclopropene, the transition state for the Diels-Alder reaction between 1,3-cyclopentadiene and cyclopropene, and (E,E,E,E,E)-1,3,5,7,9-decapentaene have been calculated within the recently introduced GAPT population analysis. Effects of different basis sets and electron correlation on the atomic charges have been examined. On the basis of these studies it is found that the GAPT population analysis should be recommended as a standard tool for analyzing the electronic structure of organic molecules and transition states.

47329 Solid-state NMR of ^{13}C in ethylene adsorbed on silica-supported ruthenium. Pruski, M. (Iowa State Univ., Ames (USA)); Kelzenberg, J.C.; Gerstein, B.C.; King, T.S. *Journal of the American Chemical Society (USA),* 112(11): 4232-4240 (23 May 1990). DOE Contract W-7405-ENG-82.

A variety of experimental nuclear spin dynamics on ^{13}C, including standard cross-polarization (CP), CP with magic angle spinning (CP/MAS), CP/MAS with dipolar dephasing, and single-pulse experiments with and without proton decoupling have been applied to the study of adsorption and reaction of ethylene on silica-supported ruthenium. NMR of ^{13}C using CP/MAS allowed us to simultaneously observe the transformations of chemisorbed and weakly adsorbed molecules during reaction of ethylene to form products. Direct ^{13}C

excitation allowed quantitative measurements of the various species present. From these experiments it was determined that the decomposition of ethylene at room temperature formed strongly adsorbed species such as acetylide and alkyl groups. Recombination of adsorbed species and hydrogenation of ethylene occurred rapidly at room temperature, forming weakly adsorbed ethane and cis- and trans-2-butene that subsequently hydrogenated to butane.

47330 Reduction of an electronically unsaturated transition-metal η^2-acyl complex. Arene formation from deoxygenative acyl coupling with a cyclopentadienyl ligand. Meyer, T.Y. (Univ. of Iowa, Iowa City (USA)); Messerle, L. *Journal of the American Chemical Society (USA),* 112(11): 4564-4565 (23 May 1990).

η^2-Acyl ligands are common products from carbonylation of early-transition-metal, lanthanide, and actinide alkyls and have been studied primarily from a synthetic or structural rather than a reactivity perspective. Our interests in mid-valent, mono(η-C_5R_5) early-metal chemistry and in the comparative structure/reactivity of organometallic functional groups in complexes with different metal valencies led us to examine whether an electronically unsaturated η^2-acyl complex would deinsert, rearrange to a ketene hydride, have altered η^2-interaction and reactivity, or undergo structural rearrangement upon reduction. We have discovered an example of the latter, specifically that η^2-acyl reduction can lead to deoxygenative coupling with a cyclopentadienyl C_{ring}-C_{ring} bond.

47331 Isomerization of the cubane radical cation to the bridged 1,4-bishomobenzene (bicyclo[3.3.0]octa-2,6-diene-4,8-diyl) radical cation. Qin, X.Z. (Argonne National Laboratory, IL (USA)); Trifunac, A.D.; Eaton, P.E.; Xiong, Y. *Journal of the American Chemical Society (USA),* 112(11): 4565-4567 (23 May 1990).

The electronic structure and the interconversion of the radical cations of the $(CH)_8$ group have recently attracted attention. Among the $(CH)_8$ hydrocarbons, cubane has high symmetry (O_h) and the highest strain energy. Its physicochemical properties continue to attract experimental and theoretical interest. The cubane radical cation (1) was first studied in neon matrices at 4 K. Here we report isomerization of 1 to the bridged 1,4-bishomobenzene radical cation (2), which was first demonstrated to be formed by the ring-opening of the semibullvalence radical cation. We show here that radiolytic oxidation of cuneane also yields 2.

47332 $[(MeC_5H_4)_3U]_2[\mu$-1,4-$N_2C_6H_4]$: A bimetallic molecule with antiferromagnetic coupling between the uranium centers. Rosen, R.K. (Univ. of California, Berkeley (USA)); Andersen, R.A.; Edelstein, N.M. *Journal of the American Chemical Society (USA),* 112(11): 4588-4590 (23 May 1990). DOE Contract AC03-76SF00098.

Antiferromagnetic coupling of electron spins on two or more metal centers that are connected by bridging ligands, referred to as indirect coupling or superexchange coupling, is a topic of considerable interest in d-transition-metal chemistry. Antiferromagnetic coupling has been observed in a molecular lanthanide system, $Cp_4Dy_2(\mu$-$Br)_2$, with an order temperature of 6 K. Magnetic susceptibility and electron paramagnetic resonance (EPR) measurements have been carried out on a number of mononuclear, pentavalent uranium compounds of the type $(MeC_5H_4)_3UNR$.

47333 Flexibility of the zeolite RHO framework. In situ X-ray and neutron powder structural characterization of divalent cation-exchanged zeolite RHO. Corbin, D.R. (E. I. du Pont de Nemours and Company, Inc., Wilmington, DE (USA)); Abrams, L.; Jones, G.A.; Eddy, M.M.; Harrison, W.T.A.; Stucky, G.D.; Cox, D.E. *Journal of the American Chemical Society (USA),* 112(12): 4821-4830 (6 Jun 1990). DOE Contract AC02-76CH00016.

Zeolite RHO has an unusual three-dimensional monolayer surface with a topology that gives equal access to either side of the surface. In the absence of supporting structural subunits, e.g., smaller cages or channels, RHO exhibits atypical framework flexibility with large displacive rearrangements. These have been investigated by in situ X-ray powder diffraction studies of zeolite RHO exchanged with various divalent cations. The unit cell variation (e.g., Ca,H-RHO (400°C), a = 13.970 (5) Å; Sr-RHO (250°C), a = 14.045 (1) Å; Ba-RHO (200°C), a = 14.184 (2) Å; Cd-RHO (350°C), a = 14.488 (3) Å; Na,Cs-RHO (25°C), a = 15.031 (1) Å) is a particularly sensitive function of cation and temperature. Rietveld analysis of neutron diffraction data was used to refine the structures of two samples, Ca,ND_4-RHO and Ca,D-RHO. Ca,D-RHO shows the largest reported deviation from $Im\bar{3}m$ symmetry (a = 13.9645 (7) Å) for a RHO structure.

47334 An attractive cis-effect of hydride on neighbor ligands: Experimental and theoretical studies on the structure and intramolecular rearrangements of $Fe(H)_2(\eta^2$-$H_2)(PEtPh_2)_3$. Van Der Sluys, L.S. (Indiana Univ., Bloomington (USA)); Huffman, J.C.; Caulton, K.G.; Eckert, J.; Hall, J.H.; Kubas, G.J.; Vergamini, P.J.; Eisenstein, O.; Jackson, S.A.; Koetzle, T.F. *Journal of the American Chemical Society (USA),* 112(12): 4831-4841 (6 Jun 1990). DOE Contract AC02-76CH00016.

The compound of formula $FeH_4(PEtPh_2)_3$ has been established by neutron diffraction to possess the structure and linkage cis,mer-$Fe(H_2)(PEtPh_2)_3$, and thus be generally similar in structure to cis,mer-$Fe(H)_2(N_2)(PEtPh_2)_3$, whose structure has been determined by X-ray diffraction. The Fe-hydride distances in $Fe(H)_2(PEtPh_2)_3$ are 1.538 (7) Å (trans to H_2) and 1.514 (6) Å (trans to $PEtPh_2$), and the Fe-H (of H_2) distances are 1.607 (8) and 1.576 (9) Å. The H-H distance in coordinated dihydrogen is 0.821 (10) Å, but the H-H bond adopts an orientation unique among structurally characterized octahedral H_2 complexes: staggered with respect to the cis Fe-P and Fe-H axes. Vibrational frequencies of the $Fe(H)_2(H_2)$ substructure have been measured by difference inelastic neutron scattering spectroscopy. Neutron scattering also reveals the low-frequency rotational tunneling splitting, allowing estimation of the height of the torsional barrier for coordinated H_2 rotating about its midpoint (~1 kcal/mol).

47335 Spontaneous oxidation of xenon to Xe(II) by cationic Ag(II) in anhydrous hydrogen fluoride solutions. Zemva, B. (Edvard Kardelj Univ., Ljubljana (Yugoslavia)); Lutar, K.; Jesih, A.; Hagiwara, R.; Casteel, W.J. Jr.; Bartlett, N. *Journal of the American Chemical Society (USA),* 112(12): 4846-4849 (6 Jun 1990).

Blue solutions, prepared by dissolving AgF_2 in anhydrous hydrogen fluoride (AHF) with BF_3 or AsF_5, oxidize Xe, at ~20°C, to produce nearly colorless solids. Overall reactions (all in AHF) are as follows: $2AgF_2 + 2BF_3 + Xe \rightarrow XeF_2 + 2AgBF_4$; $4AgF_2 + 5AsF_5 + 2Xe \rightarrow Xe_2F_3AsF_6 + 4AgAsF_6$. Solid AgF_2 does not interact, at ~20°C, with Xe. Ag(I) in AHF is catalytic to the interaction of Xe with F_2 ($Xe + F_2 \rightarrow XeF_2$), but XeF_2 precipitates AgF_2 from Ag(II) AHF solutions (e.g. $AgFAsF_6 + 2XeF_2 \rightarrow Xe_2F_3AsF_6 + AgF_2$). To maintain the Ag(II) catalyst the fluoride-ion donor, XeF_2, must be neutralized with acid, e.g. $2Xe + 2F_2 + AsF_5 \rightarrow Xe_2F_3AsF_6$.

47336 Cavities in molecular liquids and the theory of hydrophobic solubilities. Pohorille, A. (Univ. of California, Berkeley (USA)); Pratt, L.R. *Journal of the American Chemical Society (USA),* 112(13): 5066-5074 (20 Jun 1990).

Thermal configurational data on neat liquids are used to obtain the work of formation of hard spherical cavities of atomic size in six molecular solvents: n-hexane, n-dodecane, n-undecyl alcohol, chloroform, carbon tetrachloride, and water. These results are used to test a recent suggestion that the differences between nonaqueous solvents and liquid water in solvation of inert gases are not principally due to the hydrogen-bonded structure of liquid water but rather to the comparatively small size of the water molecule. The frequencies of occurrence of cavities in liquid water can be meaningfully distinguished from those in the organic solvents.

47337 Kinetic and photochemical studies of $FeC_5H_6^+$ in the gas phase. Huang, Yongqing (Purdue Univ., West Lafayette, IN (USA)); Freiser, B.S. *Journal of the American Chemical Society (USA),* 112(13): 5085-5089 (20 Jun 1990). DOE Contract FG02-87ER13766.

Kinetic and photochemical studies were performed on $FeC_5H_6^+$. $FeC_5H_6^+$ was prepared by reacting Fe^+ with cyclopentene and subsequently with propane to give the cyclopentadienylallyiron ion. $D°(Fe^+$-cyclopentadiene) was determined by photodissociation threshold measurements to be 55 ± 5 kcal/mol, which in turn indicates that dehydrogenation of cyclopentene by Fe^+ is 33 ± 5 kcal/mol exothermic. Linear kinetics are observed by collisionally cooling the $FeC_5H_6^+$ ions in a high-background pressure of argon and

yield a rate constant of $5 \pm 2 \times 10^{-10}$ cm^3/(molecule x s), corresponding to a reaction efficiency of about 0.4. Photodissociation of the cyclopentadienyallyliron ion yields two product ions, $FeC_8H_8^+$ and $FeC_6H_6^+$, with the latter pathway, the higher energy process, prevailing when there is no background argon.

47338 Aluminirene ($HAlC_2H_2$) and aluminirane ($HAlC_2H_4$): Aluminum-substituted counterparts of cyclopropene and cyclopropane. Xie, Yaoming (Univ. of Georgia, Athens (USA)); Schaefer, H.F. III. *Journal of the American Chemical Society (USA),* 112(14): 5393-5400 (4 Jul 1990). DOE Contract FG09-87ER13811.

The theoretical molecular structures, energetics, and vibrational frequencies of isomers of HAl-acetylene and HAl-ethylene have been predicted by ab initio quantum mechanical methods. Standard double-ζ plus polarization (DZ+P) basis sets, triple-ζ plus polarization (TZ+P), and triple-ζ plus double polarization (TZ+2P) basis sets have been used for full geometry optimizations in conjunction with self-consistent-field (SCF) and single and double excitation configuration interaction (CISD) methods. The predictions are in good agreement among the different theoretical methods. The TZ+P CISD dissociation energies of AlC_2H_3 with respect to $AlH + C_2H_2$ were found to be 27.7 kcal/mol for the aluminirene ring structure, while $H_2AlC{\equiv}CH$ and $:AlCH{=}CH_2$ are more stable by 14.4 and 19.8 kcal/mol, respectively. Similarly the dissociation of AlC_2H_5 to $AlH + C_2H_4$ is endothermic by 6.9 kcal/mol for the aluminirane ring structure, while $H_2AlCH{=}CH_2$ and $:AlCH_2CH_3$ are more stable by 21.4 and 26.1 kcal/mol, respectively.

47339 Temperature-independent long-range electron transfer reactions in the Marcus inverted region. Liang, Nong (Argonne National Lab., IL (USA)); Miller, J.R.; Closs, G.L. *Journal of the American Chemical Society (USA),* 112(13): 5353-5354 (20 Jun 1990). DOE Contract W-31-109-ENG-38.

The Marcus theory made the remarkable prediction that rates of highly exoergic electron transfer (ET) reactions would slow down with increasing thermodynamic driving force ($-\Delta G°$) and give rise to a so-called inverted region. Although that prediction was controversial for two decades, a number of groups have now confirmed the bell-shaped free-energy dependence of rates on $\Delta G°$. According to the Marcus theory in its original, classical form, the inverted region is caused by the reappearance of an activation energy when the negative free energy is larger than λ, the reorganization energy. The authors report here the measurements of the temperature dependence of two highly exoergic intramolecular ET reactions providing a direct critical test of this theory.

47340 An unprecedented propellane-to-spirofused skeletal rearrangement upon oxidative demetalation of CpCo-complexed polycyclic dienes: Synthesis of a pentacyclic, potential precursor to strychnine. Grotjahn, D.B. (Univ. of California, Berkeley (USA)); Vollhardt, K.P.C. *Journal of the American Chemical Society (USA),* 112(14): 5653-5654 (4 Jul 1990).

The presence of what might be envisaged to become rings I-IV of the synthetically challenging, convulsant poison strychnine (1) in complexes of the type 2, recently made readily available by the CpCo mediated one-step fusion of rings III and IV to the indole nucleus, led them to initiate investigations aimed at effecting the oxidative cyclization of 2 to 3, in analogy to related ring-closures found with (diene)$Fe(CO)_3$ complexes. In contrast to the chemistry of the latter, they report that compounds 2 undergo nondemetalative oxidation to the propellanes 5, from which the ligands can be removed intact or in the spirofused form 4 (containing, according to IUPAC, a non-free spiro union), depending upon the reaction conditions.

47341 Reversible opening and closing of hetero trimetallic units in $(C_5H_5)_2Y(THF)Re_2H_7(PMe_2Ph)_4$ and $(C_5H_5)_2LuRe_2H_7(PMe_2Ph)_4$. Alvarez, D. Jr. (Indiana Univ., Bloomington (USA)); Caulton, K.G.; Evans, W.J.; Ziller, J.W. *Journal of the American Chemical Society (USA),* 112(14): 5674-5676 (4 Jul 1990).

Mixed-metal complexes containing two substantially different types of metal have the potential to effect substrate transformations not achievable with either of the individual metallic components. Although suitable bridging ligands have been identified for mixed-metal complexes containing f elements and transition metals, these compounds generally do not contain reactive ligands that can subsequently transfer to substrate. Transition-metal polyhydride phosphine complexes appeared to be an attractive set of starting materials for the synthesis of mixed-transition-metal/f-element species, since the several hydride ligands could provide the desired reactive ligands and also could comprise the necessary linkages to bridge to the lanthanide. Hydride-bridged heterometallic transition-metal complexes are known as well as hydride-bridged polymetallic lanthanide and yttrium complexes including mixed-metal. The authors report here the successful execution of these objectives via a new synthetic method for linking lanthanides to transition metals. As a consequence, they have observed the opening and closing of a trimetal triangle as THF adds and dissociates.

47342 Water-soluble conductive polymers. Aldissi, M. To Dept. of Energy, Washington, DC (USA). USA Patent 4,929,389/A/. 29 May 1990. Filed date 12 Feb 1988. USA Patent Application 7-155,450. Int. Cl. H01B 1/00. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes polymers which are soluble in water and are electrically conductive. The monomer repeat unit is a thiophene or pyrrole molecule having an alkyl group substituted for the hydrogen atom located in the beta position of the thiophene or pyrrole ring and having a surfactant molecule at the end of the alkyl chain. Polymers of this class having 8 or more carbon atoms in the alkyl chain exhibit liquid crystalline behavior, resulting in high electrical anisotropy. The monomer-to-monomer bonds are located between the carbon atoms which are adjacent to the sulfur or nitrogen atoms. The number of carbon atoms in the alkyl group may vary from 1 to 20 carbon atoms. The surfactant molecule consists of a sulfonate group, or a sulfate group, or a carboxylate group, and hydrogen or an alkali metal. Negative ions from a supporting electrolyte which may be used in the electrochemical synthesis of a polymer may be incorporated into the polymer during the synthesis and serve as a dopant to increase the conductivity.

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Refer also to citation(s) 46902, 46955, 47130, 47168, 47196, 47197, 47200, 47201, 47267, 47268

47343 (CONF-9007161–1) **Electroplating corners.** Gray, L.J. Oak Ridge National Lab., TN (USA). Feb 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From BETECH '90; Newark, DE (USA); 10-12 Jul 1990. Order Number DE90017023. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A recently proposed method for treating boundary corners is applied to a problem of practical interest, the simulation of an three-dimensional electrochemical plating process. At an edge point on the cathode surface there are two unknown flux (normal derivative) values, and the hypersingular integral equation for the boundary derivatives is employed to complete the linear system of equations. The additional complications arising in electroplating are the presence of singular solutions at a reentrant corner, nonlinear boundary conditions, and the close proximity of two different edges. Results for a realistic problem geometry are reported. 11 refs.

47344 (LBL–26455, pp. 92) **Electrochemical processes.** Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This program is designed to advance the scientific foundations of electrochemical engineering and to broaden the range of useful applications of electrochemical transformations. Electrolysis processes have inherent advantages over thermochemical methods with respect to material yield and energy efficiency. However, in spite of their long history of economically significant applications, cell processes have not achieved their potential with respect to performance and range of applications in chemical synthesis, nor in energy conversion or storage. A major reason for this condition is the complex nature of transport phenomena in ionic media, as they are coupled to charge-transfer processes at the electrode surface. Multicomponent transport of charged species in solution is described by a mathematical model, and the composition at the

surface experimentally determined, to clarify the mechanism of anomalous electrodeposition of magnetic alloys. In projects jointly directed with Dr. R.H. Muller, novel methods are explored for the reduction of mass-transfer resistance in high-rate applications, including in electroforming of metals, and in electroorganic synthesis. Stability analysis is used to gain insight into the development of roughness in the electrodeposition of metals.

47345 (LBL–26455, pp. 92-93) **Roughness development in metal electrodeposition: Stability theory.** Barkey, D.P.; Muller, R.H.; Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Electrodeposition of metals to thicknesses suitable for electroforming inevitably results in roughening of the deposit surface. Practical electrodeposits are polycrystalline and surface texture is amplified during deposition, resulting in macroscopic surface roughness. Roughness is a waste of material and in extreme cases leads to porous or noncoherent deposits. It arises because the process of electrodeposition is unstable to the development of protrusions that grow more rapidly than the surrounding surface. A stability analysis of metal electrodeposition on a smooth surface has been formulated and applied to copper deposition on a rotating cylinder. Current distribution on a sinusoidal profile was found by a first-order perturbation technique accounting for ohmic, kinetic, capillary, and concentration overpotentials, and the derived current distribution was used to evaluate the rate of growth or decay of the perturbation. Growth rate was expressed as a function of three dimensionless parameters. The stability analysis correctly predicts trends in roughness spatial period as it depends on current density and fraction of limiting current. Relative to earlier efforts by Aogaki and by Landolt, the analysis improves agreement with experimental observations over a wide range of deposition conditions on the basis of quite fundamental considerations and without any adjustable parameters. However, while trends are correctly predicted, magnitudes of protrusion spacing are roughly twice those calculated by the present treatment.

47346 (LBL–26455, pp. 93) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

It is known that certain metals interact when codeposited in such a way that their discharge kinetics are altered; the less noble metals deposit in preference to the more noble ones. Iron group metals, and zinc or palladium, are examples of such systems; when codeposited, the ratio of the less noble to the more noble metal is significantly higher in the deposit than in the solution phase. Despite the widespread occurrence and technical importance of these materials (e.g., thin magnetic films, corrosion protective layers, electronic devices), the mechanism of this behavior is not well understood. The authors have developed a mathematical model to describe the liquid-phase mass transport from basic principles. The rotating-disk electrode with its well-characterized hydrodynamics is used both in experiments and mathematical modeling. Homogeneous reactions, such as metal hydroxide ion formation, water dissociation, and buffering effects (e.g., boric acid), are included. The concentration profiles of all the species are calculated, and the interfacial values are used to evaluate more precisely the kinetic parameters of various electrode reactions. The authors have taken into account the discharge of both hydrogen ions and water during hydrogen evolution, and the discharge of both metal and metal-hydroxide ions during the metal deposition. The authors first-order kinetic models (i.e., simple Butler-Volmer type without introducing any adsorption models) indicate that the difference in the discharge rate of metal-hydroxide ions and their dissociation constant are the key factors in the anomalous deposition behavior.

47347 (LBL–26455, pp. 101) **Electrochemical phase boundaries.** Muller, R.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Nucleation and growth processes in the electrocrystallization of metals from aqueous media are investigated to advance the understanding of the propagation of deposit properties from the first atomic layers to macroscopic thicknesses. The effect of adsorbed molecules is studied in the early stages of deposition to gain insight into the action of leveling and brightening agents and their effect on the properties of thin-film metal deposits. Such agents are used on an empirical basis in technical electro-deposition, but for applications in new systems, a greater understanding of their function is necessary for their selection and the prediction of their effects. New experimental techniques are developed and used for determining microtopographies and chemical constituents at deposit surfaces, particularly while they are immersed in the electrolyte: the development of microtopographies is followed in situ by scanning tunneling microscopy (STM) and ex situ by stylus profilametry with digital data analysis, and optical and electron microscopy. Adsorbed materials on electrode surfaces are determined in situ by Raman spectroscopy and spectroscopic ellipsometry, which are sensitive to monolayer coverages of some materials. Additives incorporated in metal deposits are determined ex situ by Auger electron spectroscopy (AES), x-ray photoelectron spectroscopy (XPS), and secondary-ion mass spectroscopy (SIMS). The results of measurements are compared to predictions of theoretical models.

47348 (LBL–26455, pp. 101-102) **STM of Cu electrodeposited in the presence of benzotriazole.** Armstrong, M.J.; Muller, R.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Effects of the leveling agent benzotriazole (BTA) on the microtopography of copper deposited under controlled potentials on a Pt(111) surface have been investigated by continuous canning with the probe of a STM during deposition from 10mM $Cu(ClO_4)_2$, 0.5 M $NaClO_4$, pH 2, with and without 10 μM BTA. The electrochemical cell contained an electrolyte volume of 0.05 ml, with reference and counter electrodes in separate cells connected by capillary tubing. Deposits from BTA-free electrolyte showed long-range order exceeding the width of the probe scan of 0.6 μm, with the deposition occurring at the edges of crystal facets. In the presence of BTA, no faceting or long-range order was observed. Atomically smooth planes on the bare Pt surface, separated by 20-Å ledges, became wavy, with an amplitude of 5 Å and a period of about 200 Å, following a potential pulse of 0.5 sec to – 500 mV vs Cu. This observation is proposed to represent the formation of the first monolayer of deposit in the form of islands. During subsequent deposition at – 20 mV, elongated nuclei of 20 Å height and 500 Å width were observed after 90 sec of deposition.

47349 (LBL–26455, pp. 102-103) **Island films resulting from ion bombardment.** Armstrong, M.J.; Muller, R.H. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The ion bombardment of compact Pb films less than 100 nm thick has been found to result in a nonuniform removal of material and the formation of island films. This observation differs from the uniform removal on which the determination of composition profiles by AES is based. The process is independent of the film preparation or the presence of an oxide overlayer. AES measurements interpreted in terms of surface coverage (rather than composition) agree well with ellipsometer measurements interpreted by the use of the coherent-superposition model for patchwise film coverage, developed earlier, thus supporting the validity of this optical model.

47350 (LBL–26455, pp. 103) **Studies on high-speed electroforming.** Barkey, D.P.; Muller, R.H.; Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Studies of high-speed copper electrodeposition have been undertaken to assess the potential for electroforming at rates comparable to those of shaping by mechanical means. The Fourier analysis of surface profiles of deposits showed a decrease in roughness amplitude and protrusion spacing with increasing current density at constant fraction of limiting current. These results agree with predictions based on the effect of mass-transport boundary layers that follow the contours of the larger surface features and are consistent with the observed higher nucleation density caused by higher kinetic overpotential.

47351 **Relative electron donor strengths of tetrathiafulvene derivatives: Effects of chemical substitutions and the molecular environment from a combined photoelectron and electrochemical study.** Lichtenberger, D.L. (Univ. of Arizona, Tucson (USA)); Johnston, R.L.; Hinkelmann, K.; Suzuki, Toshiyasu; Wudl, F. *Journal of the American Chemical Society (USA),* 112(9): 3302-3307 (25 Apr 1990). DOE Contract FG02-86ER13501.

Interest in organic metals and superconductors has prompted studies of the effects of chemical substituents on the organic electron donor tetrathiafulvalene (TTF). Electron-donating substituents on TTF should lead to reduced ionization potentials and generally greater electron transfer in organic donor/acceptor compounds. However, the relative electron donor abilities may also be influenced by their molecular environment and intermolecular interactions. In order to address these questions, the valence ionization potentials of TTF and two derivatives, bis(ethylenedioxo)tetrathiafulvalene (BEDO-TTF) and bis(ethylenedithio)tetrathiafulvalene (BEDT-TTF), have been measured in the gas phase by photoelectron spectroscopy and compared with oxidation potentials from solution electrochemical measurements in a variety of solvents. The order of decreasing first ionization potentials is BEDT-TTF ≈ TTF (6.7 eV) > BEDO-TTF (6.46 eV).

47352 **Ferromagnetic behavior of linear chain electron-transfer complexes. Decamethylferrocene electron-transfer salts of 2,5-disubstituted-7,8,8,8-tetracyano-p-quinodimethanes. Magnetic characterization of $[Fe(C_5Me_5)_2]^{n+}[TCNQI_2]^{n-}$ and structures of $[TCNQI_2]^{n-}$ (n = 0, 1, 2).** Miller, J.S. (E.I. du Pont de Nemours and Co., Inc., Wilmington, DE (USA)); Calabrese, J.C.; Harlow, R.L.; Dixon, D.A.; Zhang, J.H.; Reiff, W.M.; Chittipeddi, S.; Selover, M.A.; Epstein, A.J. *Journal of the American Chemical Society (USA),* 112(14): 5496-5506 (4 Jul 1990). DOE Contract FG02-86ER45271.

The reaction of $Fe(C_5Me_5)_2$ donor (D) and 2,5-disubstituted-7,7,8,8-tetracyano-p-quinodimethane, $TCNQR_2$ (R = Cl, Br, I, Me, OMe, OPh) acceptor (A), results in the formation of 1:1 electron-transfer complexes of $[Fe(C_5Me_5)_2]^{+\bullet}[TCNQR_2]^{-\bullet}$ composition. The structure of $[Fe(C_5Me_5)_2]^{+\bullet}[TCNQI_2]^{-\bullet}$ belongs to the centrosymmetric $P2_1/n$ space group [a = 11.131 (2) Å, b = 32.929 (5) Å, c = 8.728 (1) Å, β = 105.06 (1)°, Z = 4, V = 3,089 Å^3, R = 3.4%; R_w = 3.1% at −100°C]. The unit cell comprises $\cdots D^{+\bullet}A^{-\bullet}-D^{+\bullet}A^{-\bullet}-D^{+\bullet}A^{-\bullet}\cdots$ chains along a with the intrachain $Fe^{III}\cdots Fe^{III}$ distance of 11.131 Å and the interchain $Fe^{III}\cdots Fe^{III}$ separations less than the intrachain spacing of 8.728 (in-registry) and 9.778 Å (out-of-registry). The structure of $[(Co(C_5Me_5)_2)^+]_2[TCNQI_2]^{2-}$ belongs to the centrosymmetric $P\bar{1}$ space group [a = 9.537 (3) Å, b = 9.880 (2) Å, c = 12.728 (1) Å, α = 85.24 (1)°, β = 86.25 (1)°, γ = 81.39 (2)°, Z = 1, V = 1,180 Å^3, R = 5.4%; R_w = 5.5% at −70°C].

4005 Photochemistry

Refer also to citation(s) 47231, 47264

47353 (LBL–26455, pp. 115) **Photochemistry of materials in the stratosphere.** Johnston, H.S. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This research is concerned with global atmospheric photochemical modeling and with experimental gas-phase photochemistry. In collaboration with Lawrence Livermore National Laboratory (LLNL), theoretical studies are made of atmospheric transport, radiation balance, and photochemistry. One goal of the experimental work is to obtain optical and kinetic data in the laboratory that are needed by modelers of the atmosphere. Another goal is to measure the distribution of excess energy in the fragments produced after a molecule is broken apart by an energetic pulse of light. The experimental methods include laser flash photolysis, laser resonance absorption, resonance fluorescence, dispersed chemiluminescence from photolysis products, and infrared diode lasers. This research has applications to molecular dynamics, to problems of atmospheric ozone, and to problems of global change of trace gases in the atmosphere.

47354 (LBL–26455, pp. 116) **Collision-free fluorescence of nitrogen dioxide from the photolysis of nitryl chloride and nitrogen pentoxide.** Oh, B.Y. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Collision-free nitrogen dioxide fluorescence is induced by fast (15 nsec) excimer-laser photolysis of RNO_2 compounds at low pressure (5 mtorr). A large amount of such data was taken with variation of the photolyzed molecules and ultraviolet wavelength. The dispersed spectra give information about the internal energy distribution (first two moments) of the photolysis products, if one knows the fluorescence lifetime as a function of wavelength. A project is under way to measure the collision-free NO_2 fluorescence lifetimes, especially at wavelengths above 600 nm.

47355 (LBL–26455, pp. 116) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The fluorescence spectrum of the nitrate free radical has been studied by a sensitive photon-counting method, and several previously unobserved features have been found. In collaboration with Professor William Lester, additional quantum mechanical calculations are under way in an effort to interpret these data and to determine the structure (D3h or C2v) of this free radical. A simple pulsed molecular-beam machine has been constructed and used for preliminary study of collision-free photolysis-induced fluorescence of nitrogen dioxide.

47356 **^3P Hg, Cd, and Zn photosensitized chemistry of vinyl halides in krypton matrix.** Cartland, H.E. (Univ. of California, Berkeley (USA)); Pimentel, G.C. *Journal of Physical Chemistry (USA),* 94(2): 536-540 (25 Jan 1990). DOE Contract AC03-76SF00098.

The reaction of group IIB metals in the ^3P state with vinyl fluoride, chloride, and bromide is studied in krypton matrix. The primary process in all cases is hydrogen halide elimination to form a hydrogen halide/acetylene hydrogen-bonded complex. Insertion of metal atoms into C-Cl and C-Br bonds, but not into C-H and C-F bonds, is also observed. The insertion photochemistry can be explained by a mechanism which requires that the process occur on a triplet surface with the vinyl halide in the planar ground-state conformation.

47357 **Resonance-enhanced Raman scattering in the near-infrared region. Preliminary studies of charge transfer in the symmetric dimers $(2,2'\text{-bpy})_2ClRu\text{-}4,4'\text{-bpy-}RuCl(2,2'\text{-bpy})_2^{4+/3+/2+}$, $(H_3N)_5Ru\text{-}4,4'\text{-bpy-}Ru(NH_3)_5^{6+/5+/4+}$, and $(NC)_5Fe\text{-}4,4'\text{-bpy-}Fe(CN)_5^{4-/5-/6-}$.** Doorn, S.K. (Northwestern Univ., Evanston, IL (USA)); Hupp, J.T.; Porterfield, D.R.; Campion, A.; Chase, D.B. *Journal of the American Chemical Society (USA),* 112(13): 4999-5002 (20 Jun 1990). DOE Contract FG02-87ER13808.

Three symmetrical mixed-valence dimers (and their oxidized and reduced congeners) have been examined in solution by Raman spectroscopy with use of near-infrared excitation (1,064 nm, Nd:YAG source). The specific systems were $(2,2'\text{-bpy})_2ClRu\text{-}4,4'\text{-bpy-}RuCl(2,2'\text{bpy})_2^{4+/3+/2+}$, $(H_3N)_5Ru\text{-}4,4'\text{-bpy-}Ru(NH_3)_5^{6+/5+/4+}$, and $(NC)_5Fe\text{-}4,4'\text{-bpy-}Fe(CN)_5^{4-/5-/6-}$. For two of the mixed-valence ions, resonance-enhanced Raman scattering is found. (For the third, the decacyano ion, extensive thermal degradation occurs.) Studies of the corresponding fully reduced ions show, however, that the enhancement effects are due not to intervalence excitation but to weakly preresonant metal-to-ligand excitation.

4006 Radiation Chemistry

Refer also to citation(s) 46754, 47253

47358 (LBL–26455, pp. 97) **Materials chemistry problems in nuclear technology.** Olander, D.R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

This experimental research program has two principle objectives. The first is concerned with the chemical and physical behavior of materials of nuclear reactor systems, both fission and fusion. The experiments are designed to explore the fundamental processes that underlie the performance of these materials in their service environments, which are characterized by combinations of high temperature, intense radiation fields, and reactive gases or liquids. Solid-state diffusion in ceramic oxides, corrosion of metals for nuclear applications, and high-temperature vaporization of nuclear ceramics are investigated in this program. The second direction of the project is the study of gas-solid chemical reactions such as corrosion or etching by the method of molecular beam coupled with mass spectrometry. The objective of these studies is to understand the kinetics and mechanisms of such reactions in clean, well-characterized systems. Systems studied include halogen reaction with metals and semiconductors, and atomic hydrogen etching of refractory materials.

47359 The fate of alkane radical cations in liquid and solid hydrocarbons. Time-resolved fluorescence detected magnetic resonance. Werst, D.W. (Argonne National Lab., IL (USA)); Bakker, M.G.; Trifunac, A.D. *Journal of the American Chemical Society (USA),* 112(1): 40-50 (3 Jan 1990). DOE Contract W-31-109-ENG-38.

Time-resolved fluorescence detected magnetic resonance (FDMR) is used to observe alkane radical cations generated by electron radiolysis in liquid and solid alkane solutions. The ease of observation of the alkane radical cations (on the time scale of tens to hundreds of nanoseconds) depends strongly on the alkane under study as well as the conditions of temperature and concentration. Ion-molecule reactions such as proton transfer or H-atom transfer are responsible for the very transient nature of the alkane radical cations and possibly account for much of the diversity of hydrocarbon radiation chemistry.

47360 Direct measurement of the absolute kinetics of chlorine atom in CCl_4. Chateauneuf, J.E. (Univ. of Notre Dame, IN (USA)). *Journal of the American Chemical Society (USA),* 112(1): 442-444 (3 Jan 1990).

Ground-state singlet dichlorocarbene is the standard in the empirical correlation of carbenic selectivity that was so elegantly developed by Moss. Therefore, nearly all singlet carbene reactivity may be directly referred to by the relative reactivity of dichlorocarbene ($:CCl_2$). Recently, there have been intriguing reports, by Washio and co-workers, and earlier, by Buehler, that have tentatively assigned the UV band generated by pulse radiolysis of CCl_4 to dichlorocarbene. These reports, in view of the overall importance of $:CCl_2$ to carbene chemistry, warranted further investigation. Herein, the authors report that the above UV absorption band has been generated by three independent methods and the bimolecular reactivity of this transient shows no correlation with known singlet carbene chemistry. The transient species responsible for the absorption spectrum is, in fact, chlorine atom. Several of what represent the first directly monitored absolute bimolecular rate constants for the reactions of chlorine atom in CCl_4 are presented.

47361 Contained radiological analytical chemistry module. Barney, D.M. To Dept. of Energy, Washington, DC (USA). USA Patent 4,909,065/A/. 20 Mar 1990. Filed date 14 Apr 1989. USA Patent Application 7-337,982. Int. Cl. G01N 7/00. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a system which provides analytical determination of water chemistry parameters with respect to water samples subject to radiological contamination. The system includes a water sample analyzer disposed within a containment and comprising a sampling section for providing predetermined volumes of samples for analysis; a flow control section for controlling the flow through the system; and a gas analysis section for analyzing samples provided by the sampling system. The sampling section includes a controllable multiple port valve for, in one position, metering out sample of a predetermined volume and for, in a second position, delivering the material sample for analysis. The flow control section includes a regulator valve for reducing the pressure in a portion of the system to provide a low pressure region, and measurement devices located in the low pressure region for measuring sample parameters such as pH and conductivity, at low pressure. The gas analysis section which is of independent utility provides for isolating a small water sample and extracting the dissolved gases therefrom into a small expansion volume wherein the gas pressure and thermoconductivity of the extracted gas are measured.

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 46638, 47122, 47167, 47217, 47615, 47868, 47873, 47874, 47875

47362 (IPEN-PUB–175) **Radiochemical and biological control of metaiodobenzyl-guanidine (MIBG) labeled with ^{131}I.** Barboza, M.R.F.F. de; Muramoto, E.; Colturato, M.T.; Silva Valente Goncalves, R. da; Pereira, N.P.S. de; Almeida, M.A.T.M. de; Silva, C.P.G. da. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 9p. (In Portuguese). Order Number DE90639403. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

This study shows the standardization of the radiochemical control of MIBG - ^{131}I in eletrophoretic system and also the biological control in Wistar rat for a period of time, not longer than 60 minutes after tracer administration. (author).

47363 (IPEN-PUB–181) **Small-scale extraction and radioiodination of human hormones for the substitution of imported radioimmunoassay reagents.** Gimbo, E.K.; Carvalho Pinto Ribela, M.T. de; Borghi, V.C.; Schwarz, I.; Dias, L.E.M.; Araujo, E.A. de; Bartolini, P. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 13p. Order Number DE90639404. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

One of the main objectives of our laboratory is the national production of radioimmunoassay (RIA) reagents so to substitute the use of expensive imported commercial kits or in-bulk reagents such as the following: (a) highly purified unlabelled hormones for radioiodination, useful also for preparing secondary standards and specific antisera; (b) 125 I-labelled hormones; (c) specific high titre antisera. The extraction and purification of human growth hormone (hGH) and human luteinizing hormone (hLH) has been already carried out. We have recently obtained quite purified, active and stable preparation starting from a small number of human pituitaries, the whole process being carried out in just one or two weeks for hGH an hLH respectively. For what concernes 125 I-labelling, we basically utilize two techniques: the Classical Chloramine T method described by Hunter and Roth's stoichiometric method, both followed by a quantitative and qualitative analysis of the reaction mixture, set up in our laboratory. The results of such comparison will be discussed. 125-I-hGH, 125-I-hLH, 125-I-hTSH and 125-I-h Calcitonin (unlabelled synthetic product donated by CIBA, Switzerland) have been prepared and tested in internal and external quality control, in comparison with good quality imported products. Satisfactory results have been obtained through the evaluation of these parameters: maximum binding to specific antiserum (Bo), nonspecific binding (NSB), mean effective dose (ED 50), sensitivity, precision and accuracy. Concerning antisera production, specific and high titre rabbit anti-hGH and anti-hLH antibodies have been obtained, while guinea-pig anti-h Calcitonin antiserum is being produced. Together with 125-I-Calcitonin it will be used in the setting up of the RIA of this hormone whic allows the early detection of Medullary Thyroid Carcinoma. (author).

47364 (LBL–26455, pp. 98) **Release of fission products (Xe, I, Te, Cs, Mo, and Tc) from polycrystalline UO_2.** Prussin, S.G.; Olander, D.R.; Lau, W.K.; Hansson, L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The release of xenon, iodine, tellurium, cesium, molybdenum, and technetium from lightly irradiated, polycrystalline UO_2 has been studied in post-irradiation anneal experiments. The effective diffusion coefficients for cesium were found to be comparable to those for xenon and roughly an order of magnitude smaller than those for iodine and tellurium over the temperature range studied. Activation energies for diffusion of the more volatile elements as derived from analysis within the Booth model were 156 ± 45 (Xe), 122 ± 33 (I), 115 ± 11 (Te), and 99 ± 11 (Cs) kcal/mol. The activation energies

for Mo and Tc found by a similar treatment were 353 ± 24 and 205 ± 42 kcal/mol, respectively, and are indicative of a fairly complex mechanism for release of these elements. The soluble ionic species Np^{4+}, Zr^{4+}, La^{3+}, and Nd^{3+} were completely retained in the UO_2.

47365 (LBL–26455, pp. 98) **Surface-temperature transients from pulsed laser heating of UO_2.** Yagnik, S.K.; Olander, D.R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Surface heating of UO_2 by a pulsed laser was investigated theoretically and experimentally. Targets of solid uranium dioxide in vacuum were rapidly heated to peak temperatures of 3,700 K, as measured by a fast-response automatic optical pyrometer. The measured target surface temperatures were compared with a one-dimensional heat-transport model that accounts for conduction and melting in the solid and ablation and radiation from the surface. Congruent vaporization of UO_2 was assumed. The measured temporal and spatial characteristics of the laser beam, as well as temperature-dependent physical and thermodynamic properties of UO_2, are used as input to the calculations. Agreement of the theory with the measurements was further validated by post-irradiation microscopic examination of the target surface. Additional tests were performed to qualitatively assess the attenuation of laser light and thermal radiation from the surface by the vapor blow-off from the target. This effect was found to be insignificant.

47366 (USIP–90-01) **A multifunction editor for programming control sequences for a robot based radiopharmaceutical synthesis system: A user and reference manual.** Appelquist, G.; Bohm, C. Stockholm Univ. (Sweden). Inst. of Physics. Jan 1990. 27p. Order Number DE90639405. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A Multifunction Editor is a development tool for building control sequences for a robotized production system for positron emitting radiopharmaceuticals. This system consists of SCARA robot and a PC-AT personal computer as a controller together with general and synthesis specific chemistry equipment. The general equipment, which is common for many synthesis, is fixed to the wall of the hot-cell, while the specific equipment, dedicated to the given synthesis, is located on a removable tray. The program recognizes commands to move the robot, to control valves and to control the computer screen. From within the editor it is possible to run the control sequence forward or backward to test it and to use the single step feature to debug. The editor commands include insert, replace and delete of commands in the sequence. When programming or editing robot movements the robot may be controlled by the mouse, from the keyboard or from a remote control box. The robot control sequence consists of a succession of stored robot positions. The screen control is used to display dynamic flowchart diagrams. This is achieved by displaying a modified picture on the screen whenever the system state has been changed significantly.

47367 **Hydrogen pressures and dissociation enthalpies of americium and curium hydrides determined by Knudsen effusion mass spectrometry.** Gibson, J.K. (Oak Ridge National Lab., TN (USA)); Haire, R.G. *Journal of Physical Chemistry (USA)*, 94(2): 935-939 (25 Jan 1990). DOE Contract AC05-84OR21400.

A Knudsen effusion mass spectrometric technique has been developed for the study of milligram-sized samples of metal hydrides. This new technique is necessary for the determination of the dissociation pressures and thermal stabilities of hydrides of the scarce and highly radioactive transplutonium elements. The sensitivity of this technique was such that experiments could be carried out with as little as ~ 50 μ mol of metal. Dissociation pressures were determined for americium and curium hydrides; studies were also made with selected lanthanide hydrides, for comparison. The decomposition thermodynamics of these materials are discussed.

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 46747, 47164, 47482

47368 (DOE/ER/13860–3) **Time-resolved FTIR [Fourier transform infrared] emission studies of laser photofragmentation and chain reactions: Progress report, September 15, 1987–September 15, 1990.** Leone, S.R. Colorado Univ., Boulder, CO (USA). [1990]. 36p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER13860. Order Number DE90017223. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Recent progress is described resulting from the past three years of DOE support for studies of combustion-related photofragmentation dynamics, energy transfer, and reaction processes using a time-resolved Fourier transform infrared (FTIR) emission technique. The FTIR is coupled to a high repetition rate excimer laser which produces radicals by photolysis to obtain novel, high resolution measurements on vibrational and rotational state dynamics. The results are important for the study of numerous radical species relevant to combustion processes. The method has been applied to the detailed study of photofragmentation dynamics in systems such as acetylene, which produces C_2H; chlorofluoroethylene to study the HF product channel; vinyl chloride and dichloroethylene, which produce HCl; acetone, which produces CO and CH_3; and ammonia, which produces NH_2. In addition, we have recently demonstrated use of the FTIR technique for preliminary studies of energy transfer events under near single collision conditions, radical-radical reactions, and laser-initiated chain reaction processes.

47369 (LBL–26455, pp. 94-95) **Acid-base reactions of the transition-metal alloys.** Bularzik, J.; Cima, M.; Ebbinghaus, B.; Kouvetakis, J.; Krushwitz, K. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The generalized Lewis acid-base theory describes the platinum-group metals Rh, Ir, Pd, or Pt as bases because of their nonbonding d-electron pairs that can be shared in the vacant d-orbitals of transition metals from the third to fifth groups and the lanthanides and actinides that are described as acids. A variety of techniques have been used to characterize these interactions and to develop a bonding model of general predictive capability. One procedure has been to use an electrochemical cell with solid electrolytes such as thoria doped with yttria to determine the partial molal Gibbs energies as a function of concentration. This method is limited to rather low temperatures, in the 800 to 1,200°C range. For higher-temperature studies, gaseous-equilibria measurements have been made. Also, equilibration of nitrides and carbides with metallic phases have yielded useful data. The many oxides of Ti, V, and Nb have been used by equilibrating a pair of adjoining oxides such as $Nb_{12}O_{24}$ and NbO_2, which fix the Nb and O thermodynamic activities, with a platinum-group metal and analyzing the Nb content in the equilibrated metal phase. The cell and oxide equilibration measurements that were previously carried out for combinations of 4d metals have now been extended to combinations of 3d acids with 4d and 5d bases. The literature on the thermodynamic properties of the oxides of Ti, V, and Nb has been reviewed and tabulations prepared to provide the data needed for evaluation of the oxide equilibration results.

47370 (LBL–26455, pp. 95) **Temperature-stability range of the binary MoC phase.** Kouvetakis, J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Older compilations have described the Mo-C system in terms of the two phases Mo_2C and MoC, stable up to their melting points, although there had been reports of other phases. The definitive research of Rudy and associates in 1965-69 established two forms of Mo_2C, hexagonal $MoC_{0.8}$, stable above 1928 K, and cubic $MoC_{0.7}$, stable above 2233 K. The status of MoC (hexagonal WC type) was changed from that of a stable phase to that of a ternary phase requiring additional components for thermodynamic stability. It is difficult to equilibrate the Mo-C system at temperatures below 1,500 K. To clarify the question of the stability of MoC, heatings were carried out in a gradient furnace where samples could be annealed for many weeks in a range of temperatures. Quenched samples of high-temperature carbides as well as Mo_2C or Mo with graphite were used as starting materials. The results demonstrate

that MoC is thermodynamically stable at low temperatures and decomposes to Mo_2C and graphite above 1,300 K. From consideration of equilibrium and calorimetric data, the thermodynamic properties of MoC can be established as $S_{298}°/R = 4.41 \pm 0.3$ and $\Delta H_{298}°/R = -3,430 \pm 800$ K.

47371 (PB–90-246349/XAB) **Laminar methane-air diffusion flame with chlorine impurities: Preliminary results.** Venkatesh, S.; Saito, K.; Stencel, J.M.; Lemieux, P.M.; Hall, R.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1990. 9p. (EPA–600/D-90/051). Source: NTIS, PC A02/MF A01.

The extended abstract gives preliminary results of exploratory tests, conducted by adding chlorine to the fuel side of a well characterized methane-air flame, to study the fundamental processes accompanying the combustion of chlorinated hydrocarbons. (NOTE: Formation of products of incomplete combustion during the thermal destruction of chlorinated compounds is of current interest.) The preliminary observations are concerned with soot emissions and flame temperature. The structure of the soot particles is examined under a scanning electron microscope (SEM). The SEM studies and the temperature measurements are compared to similar studies on a methane-air diffusion flame. Results indicate no change in the temperature field between the methane-air and chlorine/methane-air diffusion flames. The SEM analyzed soot indicated the absence of chlorine, although in one case the soot exhibited a porous structure, possibly due to chlorine induced attack.

47372 **Direct rate measurements of the combination and disproportionation of vinyl radicals.** Fahr, A. (National Institute of Standards and Technology, Gaithersburg, MD (USA)); Laufer, A.H. *Journal of Physical Chemistry (USA),* 94(2): 726-729 (25 Jan 1990).

The rates of removal of vinyl radicals (C_2H_3) by means of combinations and disproportionation reactions have been directly measured at room temperature. Vacuum-ultraviolet (vacuum-UV) flash photolysis of divinylmercury was used to generate vinyl radicals, and vacuum-UV absorption kinetic spectroscopy was used to monitor the time history of vinyl radicals through their absorption at 1647.1 Å. The absolute rate constant for vinyl radical decay was determined to be 1.0×10^{-10} cm^3 $molecule^{-1}$ s^{-1}. A ratio of 4.7 for the combination/disproportionation rate constants was measured by gas chromatographic analysis of the final reaction products. Absorption coefficients for the vinyl radical absorption in the 1,650-Å region were redetermined. The absolute rate constants for combination and disproportionation are then 8.2×10^{-11} and 1.8×10^{-11} cm^3 $molecule^{-1}$ s^{-1}, respectively.

42 ENGINEERING

4202 Facilities, Equipment, and Techniques

Refer also to citation(s) 46649, 47478, 47490

47373 (IPEN-PUB–141) **Contamination confinement system of irradiated materials handling laboratories.** Lobao, A. dos S.T.; Araujo, J.A. de; Camilo, R.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jun 1988. 12p. (In Portuguese). Order Number DE90639910. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A study to prevent radioctivity release in lab scale is presented. As a basis for the design all the limits established by the IAEA for ventilation systems were observed. An evaluation of the different parameters involved in the design have been made, resulting in the especification of the working areas, ducts and filtering systems in order to get the best conditions for the safe handling of irradiated materials. (author).

47374 (K/DSRD–446) **Reliability-centered maintenance information system conceptual model.** Elrod, M.H.; Green, P.L.; Pennewell, W.J.; Ruple, S.L. Oak Ridge Gaseous Diffusion Plant, TN (USA). 31 Jul 1990. 45p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OT21400. Order Number DE90016201. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Reliability-Centered Maintenance (RCM) is an analytic approach to equipment maintenance whose goal is to provide an effective preventive maintenance program for complex equipment. This document attempts to define and model an ideal RCM Information System, compliant with Department of Defense (DoD) standards, and to define potential implementation strategies to meet this goal. Toward that end, this document presents a high-level representation of the functions that make up an RCM Information System and the data that are necessary to support those functions. The document begins by providing an introduction to the background of RCM, supplemented by supporting concepts and definitions. An illustration of the Navy's approach to RCM is followed by a discussion of the hardware and software technology that may be utilized in supporting and implementing an ideal RCM system, applicable to all services. The next section provides a description of an ideal RCM system model. It identifies general and functional requirements, such as database management and RCM analysis functions. Necessary data, including potential sources, are identified. Potential hardware and software implementation strategies for the ideal RCM system model are then presented. The steps necessary for the implementation of an ideal RCM system prototype at the depot are described, including the capture, analysis, standardization, and management of the data. Conclusions and recommendations follow. 41 refs., 7 figs., 4 tabs.

47375 (UCRL-JC–104586) **The high efficiency steel filters for nuclear air cleaning.** Bergman, W.; Larsen, G.; Lopez, R.; Williams, K.; Violet, C. Lawrence Livermore National Lab., CA (USA). Aug 1990. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900809–2: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Order Number DE90016472. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We have, in cooperation with industry, developed high-efficiency filters made from sintered stainless-steel fibers for use in several air-cleaning applications in the nuclear industry. These filters were developed to overcome the failure modes in present high-efficiency particulate air (HEPA) filters. HEPA filters are made from glass paper and glue, and they may fail when they get hot or wet and when they are overpressured. In developing our steel filters, we first evaluated the commercially available stainless-steel filter media made from sintered powder and sintered fiber. The sintered-fiber media performed much better than sintered-powder media, and the best media had the smallest fiber diameter. Using the best media, we then built prototype filters for venting compressed gases and evaluated them in our automated filter tester. 12 refs., 20 figs.

47376 **A remote canister-positioning and glass level detection system.** Goles, R.W. (Pacific Northwest Lab., Richland, WA (USA)); Hof, P.J.; Dierks, R.D.; Holton, L.K. Jr. *Nuclear Technology (USA),* 89(2): 203-216 (Feb 1990). DOE Contract AC06-76RL01830.

This paper presents a remote, contactless microprocessor-based control system has been designed, developed, tested, and used that accurately positions glass-receiving canisters beneath a radioactive liquid-fed ceramic melter and monitors the height and extent of cross-sectional glass fill. Both tasks are accomplished using in-cell gamma-ray sources and out-of-cell detection, analysis and data interpretation equipment. The system aligns the canister axis with the melter overflow section to within ~ 3 mm. The canister glass level at 11 fixed elevations is measured to within ± 5 mm, while as little as 5 mm of linear cross-sectional voiding (or equivalent glass thickness) can be detected in 30-cm-diam canisters.

47377 **Method of recycling dosimeters.** Christianson, C.L. To Department of the Navy, Washington, DC. USA Patent Application 7-511,127. 10 Apr 1990. 14p. Source: NTISPC N03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

This invention relates to the salvaging of used and or defective dosimeters for subsequent reliable use. Dosimeters are now often discarded after extended use by personnel or exposure to significant doses of gamma radiation. Such personnel dosimeters also become damaged and unreliable after long storage periods so as to provide distorted readings varying between zero and excessively

high dose reading values following either no exposure to gamma radiation or moderate exposure. Presently available procedures of pre-dose screening and/or light detergent washing of the dosimeters inadequately deal with such reading reliability problems. In so far as prolonged storage is concerned, dosimeter damage often occurs as a result of humid environmental conditions. Moisture condensation on the exposed faces of the dosimeter sensing elements causes chemical and physical changes. Thus, surface projection growths and pitting occurs as a result of such chemical changes to optically affect the sensing operation of the dosimeters after ultra-violet irradiation to induce emissions indicative of prior exposure to gamma radiation. Distortion of readings indicative of such gamma radiation exposure accordingly results from the referred to humidity caused surface degradation damage.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 46386, 48052

47378 (CNIC–00288) **An experimental study of two-phase flow instability on two parallel channel with low steam quality.** Jiang Shengyao (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Wu shaorong; Bo Jinhai; Yao Meisheng; Han Bing; Zhang Youjie. China Nuclear Information Centre, Beijing, BJ (China). 1988. 7p. (In Chinese). (TSHUNE–0008). Order Number DE90638331. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

An experimental result of two-phase flow instability on two parallel channel natural circulation with low steam quality is presented. The comparison of instability in the single channel and that in parallel channel is given. The effect of unequal inlet resistance coefficient and unequal power on the parallel channel instability is described and the behaviour of instability with equal exit steam quality in the two channel is investigated.

47379 (CONF-9005183–) **Proceedings of the eighth symposium on energy engineering sciences: Micro/macro studies of multiphase media.** Argonne National Lab., IL (USA). [1990]. 254p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 8. symposium on energy engineering sciences: micro/macro studies of multiphase media; Argonne, IL (USA); 9-11 May 1990. Order Number DE90014844. Source: NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The Eighth Symposium on Energy Engineering Sciences was held on May 9–11, 1990, at the Argonne National Laboratory, Argonne, Illinois. These proceedings include the program, list of participants, and the papers that were presented during the eight technical sessions held at this meeting. This was the eighth annual symposium sponsored by the Engineering Research Program of the Office of Basic Energy Sciences of the US Department of Energy. As the title indicates, the central theme of this year's meeting was micro/macro studies of multiphase media and related topics. Each year a group of selected researchers in the DOE/BES Engineering Research Program are invited to present their research findings in such an open forum. By organizing around a central theme, principal investigators, their associates, and other interested parties are able to engage in discussions and share thoughts on subjects of common interests. This format has been used in the Engineering Research Program instead of annual contractors' meetings and has been extremely successful since its inception in 1983. To achieve these goals, the Engineering Research Program supports about one hundred and ten research projects covering a wide spectrum of topics cutting across traditional engineering disciplines with a focus on the following three areas: (1) mechanical sciences, (2) control systems and instrumentation, and (3) engineering data and analysis. The Eighth Symposium on Energy Engineering Sciences covered the review of approximately one-fourth of the total activities sponsored by the DOE/BES Engineering Research Program. Each report will be individually catalogued.

47380 (KFK–4720) **Non-isothermal spreading of liquid drops on horizontal plates.** Ehrhard, P. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorbauelemente); Davis, S.H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Reaktorbauelemente. May 1990. 57p. Grant DE-FG02-86ER13641. Order Number DE90519937. Source: NTIS (US Sales Only), PC A04/MF A01.

A viscous-liquid drop spreads on a smooth horizontal surface, which is uniformly heated or cooled. Lubrication theory is used to study thin drops subject to capillary, thermocapillary and gravity forces, and a variety of contact-angle-versus-speed conditions. It is found for isothermal drops that gravity is very important at large times and determines the power law for unlimited spreading. Predictions compare well with the experimental data on isothermal spreading for both two-dimensional and axisymmetric configurations. It is found that heating (cooling) retards (augments) the spreading process. When the advancing contact angle is zero, heating will cause the drop to spread only finitely far. For positive advancing contact angles, sufficient cooling will cause unlimited spreading. Thus, the heat transfer serves as a sentitive control on the spreading. (orig.).

47381 (ORNL/TM–11012) **Design methodology needs for fiber-reinforced ceramic heat exchangers.** Blass, J.J.; Ruggles, M.B. Oak Ridge National Lab., TN (USA). Aug 1990. 47p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90016659. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this report is to identify significant development and validation needs that must be satisfied to establish a viable design methodology for use of ceramic-fiber-reinforced, ceramic-matrix composite materials in advanced heat exchangers for high-temperature and high-pressure applications. This is part of an initiative undertaken by the US Department of Energy (DOE), Office of Industrial Programs (OIP), to foster the development and commercialization of high-pressure heat-exchange systems (HiPHES). Previous studies identified several industrial applications of HiPHES technology in which the use of fiber-reinforced ceramic composites can provide very significant benefits. The studies resulted in a recommended development program that includes an early assessment of design methodology needs for these materials and applications. To provide this assessment, Oak Ridge National Laboratory (ORNL) assembled a panel of experts with government, university, and industrial affiliations. The present panel met in April 1988 for presentations and discussions related to structural design methodology for fiber-reinforced ceramic heat-exchanger components. This report is based, in part, on those discussions and on written contributions subsequently provided by panel members. 38 refs., 1 fig., 1 tab.

47382 (PNL-SA–17526) **Advanced ceramic fabric body mounted radiator for Space Station Freedom Phase 0 design.** Webb, B.J.; Antoniak, Z.I.; Pauley, K.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900619–7: 5. AIAA/ASME thermal physics and heat transfer conference, Seattle, WA (USA), 18-20 Jun 1990). Order Number DE90016361. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A body mounted radiator concept constructed of advanced ceramic fabric materials for use with the Phase 0 design of Space Station Freedom is described. The radiator is expected to weigh between 1.4 and 3.5 kg/m^2 of single sided radiating surface, use ammonia working fluid, be highly deployable, and exhibit good reliability characteristics. This compares well with the 11.8 kg/m^2 for two sided radiators proposed for the current space station design.

47383 **Apparatus and method for spraying liquid materials.** Alvarez, J.L.; Watson, L.D. To Dept. of Energy, Washington, DC (USA). USA Patent 4,919,853/A/. 24 Apr 1990. Filed date 21 Jan 1988. USA Patent Application 7-146,631. Int. Cl. B29B 9/10. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method for spraying liquids involving a flow of gas which shears the liquid. A flow of gas is introduced in a converging-diverging nozzle where it meets and shears the liquid into small particles which are of a size and uniformity which can be controlled through adjustment of pressures and gas velocity.

4205 Materials Testing

Refer also to citation(s) 46627, 46732, 46892, 47379, 47474, 47476

47384 (AD-A–221985/5/XAB) **Physics and techniques for the investigation of the properties of ultra-small systems. Final report, 15 January 1987-14 January 1990.** Parpia, J.M.; Richardson, R.C. Cornell Univ., Ithaca, NY (USA). Dept. of Physics. 9 May 1990. 25p. Grant AFOSR-87-0148. Source: NTIS, PC A03/MF A01.

This program is directed toward the study of transport and non-equilibrium thermal effects in diverse miniaturized systems at low temperatures. The research fabricates and probes the behavior of materials without affecting their internal structure. The techniques extend our ability to characterize materials as well as to understand the effects of technology used in patterning and fabricating small devices. The techniques developed in this research should prove to be useful for the non-destructive evaluation of the properties of materials as well as for the design of miniaturized superconducting devices.

47385 (EPRI-NP–6948) **Evaluation and technologic improvement of an enhanced imaging system: Phase 3, Metallurgical evaluation: Final report.** Henry, D. (General Electric Co., San Jose, CA (USA). Nuclear Energy Div.). Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Div. ©Aug 1990. 40p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

Feature-based systems that combine imaging and signal analysis capabilities may be useful for nondestructive evaluation (NDE) of plant components. This report describes the metallurgical evaluation conducted to verify the performance of a feature-based system to discriminate intergranular stress corrosion cracking (IGSCC) from benign geometrical reflectors. The ultrasonic examination results were also evaluated by examination personnel trained in intergranular stress corrosion cracking (IGSCC) detection techniques. The welds were examined prior to their removal from the recirculation and Residual-Heat-Removal (RHR) piping systems of the Peach Bottom Atomic Power Plant, as described in the Phase 2 Interim Report issued in June 1989. In this phase of the program, a metallurgical evaluation was performed on piping system welds that were examined ultrasonically using a feature-based system for analysis. The feature-based system correctly identified crack, but incorrectly identified other features, e.g., root geometry and metallurgical interfaces, as cracks. While the results of the analysis by the feature-based system were not identical to the results of analysis by trained personnel, the overall performance of the feature-based system was comparable to that of the trained personnel. Based on the results of this program, the feature-based system may be useful as a supplementary method of identifying IGSCC indications. When used in conjunction with existing methods and techniques, it could improve the accuracy of IGSCC identification.

47386 (PSI–57) **Acoustic emission measurements at the pressure vessel ZB2: Local monitoring of the defect No. 8.** Tirbonod, B. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Hanacek, L. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1990. 126p. (In German). Order Number DE90638364. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

The work presented here is the Swiss contribution to the project 'Zwischenbehaelter 2 (ZB2)' hosted by the 'Bundesministerium fuer Forschung und Technologie' of the Federal Republic of Germany. One of the crack-like defects introduced at the inside surface of the thick-walled pressure vessel ZB2 was locally monitored by acoustic emission. The measurement system was broadband (0.5 - 5 MHz) and allowed a threedimensional location of the source. The vessel was subjected to different tests. Signals were recorded during the second series of hydrotests, fast pressure cycles and fatigue test at 50 C. About 1 signal per hydrotest or cycle was recorded. For the hydrotests the signals were recorded generally at loading in the intermediate range of pressure; the sources were located in the artificial defect. Recurrent and non recurrent signals were recorded during the fatigue test. At loading, signals were captured up to the maximum pressure and for the recurrent signals at well defined pressure ranges. All the sources (except one, located in the base material ahead of the artificial defect) were situated in the artificial defect. The pressure and location depended on the loading phase and on the cycle range. The measurements were discussed by describing the signals by measurement, signal and source parameters. The goal was to identify the source mechanism and to assess the growth of the defect. For the hydrotests the identification of the mechanism at loading remains open. For the fatigue test the source situated in the base material was attributed to a primary mechanism; this source could assess the growth of the defect on the basis of linear elastic fracture mechanics. A secondary mechanism was suggested for recurrent sources active at loading. For all the tests, the sources active at unloading were attributed to a secondary mechanism. (author).

47387 (SAND–90-1583C) **Development of the force envelope for an acceleration/force extremal controlled vibration test.** Smallwood, D.O. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9010172–1: 61. shock and vibration symposium, Pasadena, CA (USA), 16-18 Oct 1990). Order Number DE90015712. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A method is presented for determining the force spectral density function for a vibration test where a combination of force and acceleration is used for control. First the acceleration spectral density is established based on an envelope of the interface motion between the test item and the mounting structure (the base) in the use (field) environment. The driving point accelerance (acceleration/force) of the test item is measured at the mounting interface. The force required to drive the test item in an acceleration controlled test is then estimated. A force spectral density is then established using the estimated motion controlled force, and a derived force reduction factor. An extremal control vibration test is then performed based on which parameter (input force or input acceleration) reaches based on which parameter (input force or input acceleration) reaches its envelope first. 7 refs., 7 figs., 2 tabs.

47388 (VTT-TIED–1082) **A view of NDT-methods used in steam turbine tests.** Sarkimo, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1990. 28p. (In Finnish). Order Number DE90518712. Source: NTIS (US Sales Only), PC A03/MF A01.

The demand of the high utilization rate and safety in steam turbine operation requires wide application of nondestructive testing (NDT) methods. The surface methods. visual techniques, endoscopy and magnetic particle testing are frequently applied. The information of inside defects in the massive components of steam turbines is also of great importance already during the fabrication process. For that purpose the volumetric inspection methods are applied and of them the ultrasonic testing method is used most frequently. When there is a effort to short outages and to high utilization rate, the speed and the ability to detect defects of the NDT-methods are more and more important. The modern strength calculation methods need accurate measurements of defect size, location and orientation in order to be able to predict reliably the significance of the defect in the structure. To achieve these goals there is strong need for further development of the methods and for the automation of the testing, data recording and data analysis. The assessment of remaining life time of old turbines requires reliable information about the material internal structure to be able to apply calculation methods. In this sector there seems to be lack of good NDT-methods in spite of strong need.

47389 (WHC-SA–0872) **Structural integrity assessment of concrete slabs by nondestructive examination and Fourier transform-infrared methods.** Rebagay, T.V.; Dodd, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1990. 7p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. (CONF-9007109–2: Rocky Mountain analytical conference, Denver, CO (USA), 30 Jul 1990). Order Number DE90017233. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A nitric acid spill occurred in a chemical preparation room causing reaction of the concrete floor with the acid. To assess the structural integrity of the reacted concrete and to define the extent of needed repairs, a nondestructive evaluation (NDE) using pulse

echo method and a Fourier transform infrared (FT-IR) spectrometric method was employed. 5 figs.

47390 (Y–2428) **Evaluation of nondestructive evaluation techniques for determination of flawed conditions and the effects of flaws on the burst pressure in Kevlar-epoxy filament-wound spherical test specimens.** Brosey, W.D. (Oak Ridge Y-12 Plant, TN (USA)); Calfee, M.T.; Whittaker, J.W.; Waldrop, D.A.; Henneke, E.G.; Post, D.; Reifsnider, K.L.; Blake, R.A. Oak Ridge Y-12 Plant, TN (USA). Dec 1989. 92p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE90014839. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A study of nondestructive evaluation techniques on spherical filament-wound Kevlar-epoxy test specimens has been performed, and the results are presented. The objectives of the study were (1) to determine the sensitivity of several NDE techniques for the detection of a series of flaw conditions in an enclosed geometry and (2) to determine which flaw conditions affected the mechanical strength of the composite specimens. Seventy spherical specimens were made. Ten of the specimens contained one of seven defect conditions which simulated manufacturing or handling defects. Defect conditions involving delaminations, voids, inclusions, loss of fiber, loss of matrix, reduced fiber modulus, or matrix cracking were readily detectable with one or more inspection techniques. Specimens with fiber tension variation could not be distinguished from standard no-defect specimens with the inspection techniques used in this study. It was found that nominal defects introduced during the manufacturing or handling process do not significantly reduce the ultimate burst strength of the composite material in this geometry; however, impact damage was found to significantly affect burst pressure and location. Acousto-ultrasonic and acoustic emission techniques were found to be predictive of burst pressure for specimens with a normal matrix. Low-epoxy matrix specimens were found to sustain more damage for a given impact energy than specimens containing a normal matrix. 23 refs., 3 tabs.

4220 Mining and Underground Engineering

Refer also to citation(s) 46615

4230 Marine Engineering

47391 (FRNC-TH–3641) **Probabilistic approach of elasto-plastic behavior of offshore structure under stochastic wave forces.** Arroyo-Contreras, M. Ecole Nationale des Ponts et Chaussees (ENPC), 75 - Paris (France). Mar 1989. 191p. (In French). Order Number DE90518449. Source: NTIS (US Sales Only), PC A09/MF A01.

This work studies the reliability analysis of a Jacket-type offshore structure, under the action of wave forces. The mechanical model includes various elasto-plastic diagrams with and without the combination of the normal force and the bending moment. A diminution of the normal force is introduced in order to account for buckling. A linearisation is introduced for easier application. The dynamic wave forces on the structure are assumed to have zeromean, Gaussian characteristics (a gaussian stationary and ergodic random process with zero mean value) when suitably linearized. The safety index is computed, for each failure limit state of the system, by the branch and bound method, with the help of equivalent hyperplanes in a first order approximation; an hydrid method is also developed, which requires a Monte-Carlo simulation. Two examples of a portal frame structure and a jacket-type offshore structure illustrate this approach and show the effect of considering the interaction between the normal force and the bending moment in the reliability level of a system.

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 47132, 47384, 47417, 47431, 47451, 47453, 47777, 47820, 47822, 48059, 48064, 48065

47392 (AD-A–221977/2/XAB) **Generalized averaging method for power-conversion circuits. Technical report.** Sanders, S.R.; Noworolski, J.M.; Liu, X.Z.; Verghese, G.C. Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Information and Decision Systems. Jun 1990. 9p. Grant AFOSR-88-0032. (LIDS-P–1970). Source: NTIS, PC A02/MF A01.

The method of state-space averaging has been successfully applied to pulse-width modulated power converters, but has its limitations with switched circuits that do not satisfy a small ripple condition. This work considers a more general averaging procedure that encompasses state-space averaging and is potentially applicable to a much broader class of circuits and systems. In particular, the technique is shown to be effective on a number of examples including resonant type converters.

47393 (AD-A–222085/3/XAB) **Composite ceramic superconducting wires for electric-motor applications. Quarterly report No. 7, 1 January-31 March 1990.** Halloran, J.W. Ceramics Process Systems Corp., Milford, MA (USA). 30 Apr 1990. 79p. Contract N00014-88-C-0512, DARPA Order-9525. (CPS–90-010). Source: NTIS, PC A05/MF A01.

Silver clad polycrystalline Y-123 wire is being fabricated with a continuous reel-to-reel process. Scale-up activities are underway to produce enough wire for the field coils of the HTSC motor. We have produced green HTSC fiber is kilometer lengths, and sintered wires up to 166 meters long. The 77K Jc values are 1000-2800 A/sq cm in self field. To improve Jc of the Y-123 wire, development began on directional crystallization, including preliminary work at A.D. Little and Oak Ridge National Lab. Large lots of BiSCCO material were produced to fabricated fibers and sintered polycrystalline BiSSCO wire as rolled tape. Work continued in collaboration with Sandia and Los Alamos National Laboratories on rapid thermal processing of Y-123, with most emphasis on characterizing the rapid oxygenation effect. The design of the HTSC homopolar motor has been improved to increase the output from field coils by using six smaller coils, each with separately optimized current. Motor construction is in progress. Preliminary design is underway on a DC heteropolar motor with HTSC field windings and armature and a brushless trapped flux permanent magnet DC motor, in which the field is produced by trapped flux in an HTSC rotor.

47394 (AD-A–222392/3/XAB) **Intracavity frequency doubling of a Nd:YAG laser with an organic nonlinear optical crystal. Interim report.** Ducharme, S.; Risk, W.P.; Moerner, W.E.; Lee, V.Y.; Twieg, R.J. IBM Research Div., San Jose, CA (USA). Almaden Research Center. 13 Mar 1990. 17p. Contract N00014-84-C-0708. (IBM-RR-RJ–7595). Source: NTIS, PC A03/MF A01.

We have demonstrated intracavity second harmonic generation of green 532 nm light in a quasi-cw 1064 nm Nd:YAG laser using organic nonlinear optical crystals of DAN (4-(N,N-dimethylamino)-3-acetamidonitrobenzene) immersed in index matching fluid contained in an antireflection-coated cuvette. This technique permits crystals to be used directly from solution growth without polishing or antireflection coating them. Up to 0.56 mW peak power of 532 nm light was generated from 2.3 W of intracavity 1064 nm peak power in 100 microsecond pulses. We also report preliminary results on true cw intracavity harmonic generation with antireflection coated DAN crystals.

47395 (AD-A–222451/7/XAB) **High-efficiency laser dyes for high-energy dye lasers. Interim technical report No. 15, 1 June 1989-31 May 1990.** Pavlopoulos, T.G.; Boyer, J.H. Naval Ocean Systems Center, San Diego, CA (USA). 1989. 8p. Source: NTIS, PC A02/MF A01.

Pub. in Proceesings of the SPIE, 1132, 81-86(1989).

There is great demand for high-efficiency, high-energy, high-repetition-rate, wavelength-tunable lasers for many industrial and scientific applications. There is presently no laser available that both fulfills these requirements and operates in the near-ultraviolet/visible/near-infrared region of the spectrum. Dye lasers, operating with improved laser dyes, are the best near-term prospects to fill the void. Among dye lasers, those which employ flashlamps as excitation sources are technically simple and therefore relatively inexpensive. They also convert electric power most efficiently into laser light. Coaxial and linear flashlamps are available. Linear flashlamps are the least expensive. However, when a single linear flashlamp is used, dye lasers are difficult to upscale much beyond 10-Joules/pulse outputs. This results from the necessity of employing flashlamps with steep risetimes (in the microsecond range and less) to obtain laser action from the laser dye. Flashlamps meeting

this stringent requirement are difficult to build for operation above 1000 Joules.

47396 (AD-A-222474/9/XAB) **External-cavity coherent operation of InGaAsP buried-heterostructure laser array.** Diadiuk, V.; Liau, Z.L.; Walpole, J.N.; Caunt, J.W.; Williamson, R.C. Massachusetts Inst. of Tech., Lexington, MA (USA). Lincoln Lab. 1990. 13p. Contract F19628-90-C-0002. (MS–8460). Source: NTIS, PC A03/MF A01.

Pub. in SPIE, Vol. 1219 Laser-Diode Technology and Applications II, 366-376(1990).

Coherent operation of a monolithic linear array of InGaAsP buried-heterostructure lasers operating at lambda = 1.3 micron has been achieved by means of a spatial filter in an external cavity. An array of mass-transported InP microlenses was used to collimate the beams of the individual laser elements and couple the laser array output to the external cavity. The coherent array output exhibited a narrow (3.2 mrad), three-lobe far-field pattern with ~65% of the energy concentrated in the central peak.

47397 (AD-A-222558/9/XAB) **Development of a mode-locked Ti:Al_2O_3 laser. Final report, 1 August 1989-31 January 1989.** Welford, D. Schwartz Electro-Optics, Inc., Concord, MA (USA). 16 Apr 1990. 23p. Contract F49620-89-C-0089. Source: NTIS, PC A03/MF A01.

A variety of techniques for mode locking a titanium-sapphire laser were studied and analyzed.

47398 (GAO/IMTEC–90-9FS) **High-definition television: Application for this new technology.** General Accounting Office, Washington, DC (USA). Information Management and Technology Div. Jan 1990. 11p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

According to this report, high-definition television is the next generation in video technology. By increasing the number of scanning lines from 525 to over 1,000 high-definition television transmits an image that is wider than and twice as sharp as current television. This fact sheet contains information on 14 applications of high- definition television. Defense, medical, space exploration, and other uses are discussed. The report also presents the opinions of key industry officials on the effect that a high- definition television standard would have on potential applications of this technology.

47399 Single crystals. Brodsky, M.B. (Argonne National Lab., IL (USA). Materials Science and Technology Div.). *Superconductor Industry (USA),* 3(2): 32-37 (Sum 1990). DOE Contract W-31-109-ENG-38.

This paper concentrates on YBa_2Cu_3O-x. This has been grown from melts that contain Y_2O_3, BaO or $Ba(OH)_2$ and CuO. Most often, the mixtures are melted in gold—although Pt, ZrO_2 and Al_2O_3 have been used successfully under one atmosphere of oxygen and slowly cooled from around 970 C, with a fast-cooling step from 400 C. When this procedure is carried out in standard crucibles, the resulting product consists of nearly equiaxed crystals about 1–2 mm on a side. An annealing step in oxygen at 400–500 C yields crystals with Tc's around 94 K. Some physical or chemical separation of the matrix is generally necessary, although growers reduce the bulk of the molten flux by clever physical arrangements within the crucibles. Many large two dimensional crystals have been grown on sheets of gold, most often with compositions near the eutectic.

47400 Saturable induction and transformer structures for magnetic pulse compression. Birx, D.L.; Reginato, L.L. To Dept. of Energy, Washington, DC (USA). USA Patent 4,928,020/A/. 22 May 1990. Filed date 5 Apr 1988. USA Patent Application 7-176,041. Int. Cl. H05H 5/08. 16p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a saturable inductor and transformer for magnetic compression of an electronic pulse, using a continuous electrical conductor looped several times around a tightly packed core of saturable inductor material.

47401 Small bore ceramic laser tube inspection light table. Updike, E.O. To Dept. of Energy, Washington, DC (USA). USA Patent 4,925,304/A/. 15 May 1990. Filed date 30 Dec 1988. USA Patent Application 7-292,149. Int. Cl. G01N 21/88. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an apparatus for inspecting small bore ceramic laser tubes, which includes a support base with one or more support rollers. A fluorescent light tube is inserted within the laser tube and the laser tube is supported by the support rollers so that a gap is maintained between the laser tube and the fluorescent tube to enable rotation of the laser tube. In operation, the ceramic tube is illuminated from the inside by the fluorescent tube to facilitate visual inspection. Centering the tube around the axial light of the fluorescent tube provides information about straightness and wall thickness of the laser tube itself.

47402 Three-point spherical mirror mount. Cutburth, R.W. To Dept. of Energy, Washington, DC (USA). USA Patent 4,925,286/A/. 15 May 1990. Filed date 23 Jan 1987. USA Patent Application 7-008,120. Int. Cl. A47G 1/24. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a three-point spherical mirror mount for use with lasers. The improved mirror mount is adapted to provide a pivot ring having an outer surface with at least three spaced apart mating points to engage an inner spherical surface of a support housing.

47403 Tunable, continuous-wave, thulium-doped, solid-state laser cross-reference to related application. Esterowitz, L.; Stoneman, R.C. To Department of the Navy, Washington, DC. USA Patent Application 7-510,499. 30 Mar 1990. 21p. Source: NTISPC N03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

One object of the invention is to produce a room-temperature, CW laser emission continuously tunable over the spectral range of 1.86 to 2.14 microns. Another object of the invention is to provide a compact, economical, laser-pumped, solid state laser for producing a CW laser emission tunable over the spectral range of substantially 1.86 to 2.14 microns. Another object of the invention is to provide a room-temperature, laser-pumped, thulium-doped, solid state laser for producing a CW laser emission tunable over the spectral range of 1.86 to 2.14 microns and method for operating same. Another object of the invention is to provide a room-temperature, laser diode-pumped, thulium-doped, solid state laser for producing a CW laser emission tunable over the spectral range of 1.86 to 2.14 microns.

47404 Integrally formed radio frequency quadrupole. Abbott, S.R. To Dept. of Energy, Washington, DC (USA). USA Patent 4,885,470/A/. 5 Dec 1989. Filed date 5 Oct 1987. USA Patent Application 7-104,026. Int. Cl. H01J 39/36. 6p. Source: Patent & Trademark Office, Box 9 Washington, DC 20232 (USA).

This patent describes an improved radio frequency quadrupole having an elongate housing with an elongate central axis and top, bottom and two side walls symmetrically disposed about the axis, and vanes formed integrally with the walls. It comprises: the vanes each having a cross-section at right angles to the central axis which tapers inwardly toward the axis to form electrode tips spaced from each other by predetermined distances. Each of the four walls, and the vanes integral therewith, is a separate structural element having a central lengthwise plane passing through the tip of the vane, the walls having flat mounting surfaces at right angles to and parallel to the control plane, respectively, which are butted together to position the walls and vane tips relative to each other.

47405 Composite polymer-glass edge cladding for laser disks. Powell, H.T.; Riley, M.O.; Wolfe, C.R.; Lyon, R.E.; Campbell, J.H.; Jessop, E.S.; Murray, J.E. To Dept. of Energy, Washington, DC (USA). USA Patent 4,849,036/A/. 18 Jul 1989. Filed date 2 Nov 1987. USA Patent Application 7-116,806. Int. Cl. B32B 31/12. 22p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes large neodymium glass laser disks for disk amplifiers such as those used in the Nova laser. They require an edge cladding which absorbs at 1 micrometer. This cladding, described in this patent, prevents edge reflections from causing parasitic oscillations which would otherwise deplete the gain. Nova now utilizes volume-absorbing monolithic-glass claddings which are fused at high temperature to the disks. These perform quite well

but are expensive to produce. Absorbing glass strips are adhesively bonded to the edges of polygonal disks using a bonding agent whose index of refraction matches that of both the laser and absorbing glass. Optical finishing occurs after the strips are attached. Laser disks constructed with such claddings have shown identical gain performance to the previous Nova disks and have been tested for hundreds of shots without significant degradation.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 47865, 47867

47406 (CERN–90-04) **CAS CERN Accelerator School. Third advanced accelerator physics course: Proceedings.** Turner, S. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 24 Apr 1990. 230p. (CONF-8909361–: Course on advanced accelerator physics, Uppsala (Sweden), 18-29 Sep 1989). Order Number DE90639911. Source: NTIS (US Sales Only), PC A11/MF A01; OSTI; INIS.

The third version of the CERN Accelerator School's (CAS) advanced course on General Accelerator Physics was given at Uppsala University from 18-29 September, 1989. Its syllabus was based on the previous courses held in Oxford, 1985 and Berlin, 1987 whose proceedings were published as CERN Yellow Reports 87-03 and 89-01 respectively. However, the opportunity was taken to emphasize the physics of small accelerators and storage rings, to present some topics in new ways, and to introduce new seminars. Thus the lectures contained in the present volume include chromaticity, dynamic aperture, kinetic theory, Landau damping, ion-trapping, Schottky noise, laser cooling and small ring lattice problems while the seminars include interpretation of numerical tracking, internal targets and living with radiation. (orig.).

4301 Design, Development, and Operation

Refer also to citation(s) 47412, 47813, 47823

47407 (LBL–28470) **Transcript of the workshop to discuss plans for a National High Intensity Radioactive Nuclear Beam Facility.** Nitschke, J.M. (ed.). Lawrence Berkeley Lab., CA (USA). 19 Oct 1989. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-891044–12: 1. international conference on radioactive nuclear beams, Berkeley, CA (USA), 16-18 Oct 1989). Order Number DE90014890. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Following the "First International Conference on Radioactive Nuclear Beams" in Berkeley, a workshop was held on October 19, 1989 at the Lawrence Berkeley Laboratory to discuss plans for a National High Intensity Radioactive Nuclear Beam (RNB) Facility. The purpose of the workshop was – after having discussed during the conference the physics question that can be addressed with RNBs – to evaluate more concretely the possibilities for actually constructing such a facility in this country. It is becoming increasingly apparent that facility producing beams of radioactive nuclei with extreme neutron-to-proton ratios is of high scientific interest and technically feasible. It would allow the study of nuclear structure and astrophysical reactions very far from the line of stable nuclei, and could provide new possibilities of reaching the long-sought island of stability of superheavy nuclei. Such facilities are under advanced consideration in Japan and at CERN in Europe. This paper contains a slightly edited transcript of the tape recording that was made of the workshop.

47408 (SLAC-PUB–5299) **Interaction region considerations for a B-factory.** DeStaebler, H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9002128–2: Workshop on beam dynamics issues of high luminosity asymmetric collider rings, Berkeley, CA (USA), 12-16 Feb 1990). Order Number DE90016684. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The goal of the project is to observe CP violation in the $\bar{B}B$ system. This machine is supposed to be a factory for high energy physics, not an R&D project for accelerator physics. There are a number of interrelated design issues arising from the different desires of the detector and the machine, some of which are listed in this paper. A number of background and beampipe issues are mentioned. The emphasis is on calculations. Any satisfactory design will combine measurements on existing machines with calculations pertaining to the measurement conditions as well as to the proposed machine. 57 refs.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 47429, 47997, 48019

47409 (LA-UR–90-2739) **Moment methods for simulation and design.** Lysenko, W.P. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9009200–8: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90016509. Source: NTIS, PC A02/MF A01 - OSTI.

It is often advantageous to describe a particle beam by the moments of its phase-space distribution. This paper relates original work by Sacherer to presently-used linear design codes like TRACE3D and to some recent results. 15 refs., 1 fig.

47410 (LA-UR–90-2759) **Generation of a rectangular beam distribution for irradiation of the accelerator production of tritium target.** Blind, B. Lawrence Livermore National Lab., CA (USA). [1990]. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9009200–6: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90016504. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A scheme has been developed to produce a well-confined rectangular beam-intensity distribution of greatly enhanced uniformity from initially-peaked intensity distributions such as Gaussian or parabolic distributions without beam scraping. This scheme employs a system of linear and nonlinear transport-line elements. The linear elements prepare the beam for the nonlinear focusing and govern the beam size at the target. Uniformity is achieved with octupoles, and beam confinement is assured with duodecapoles. The scheme was applied to the target focus for the Accelerator Production of Tritium (APT) system. An initially Gaussian-distributed beam of 1.6-GeV protons was shaped into a rectangular 4 m by 2 m beam spot of acceptably uniform intensity at the tritium-production target. The scheme eliminates the need for sweeping the beam in a raster pattern to produce uniform target illumination. Details of the scheme are discussed.

47411 (LA-UR–90-2809) **INEX modeling of the Boeing ring optical resonator free-electron laser.** Goldstein, J.C. (Los Alamos National Lab., NM (USA)); Tokar, R.L.; McVey, B.D.; Elliott, C.J.; Dowell, D.H.; Laucks, M.L.; Lowrey, A.R. Los Alamos National Lab., NM (USA). [1990]. 24p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9009166–2: 12. international free electron laser conference (FEL-12), Paris (France), 17-21 Sep 1990). Order Number DE90016488. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present new results from the integrated numerical model of the accelerator/beam transport system and ring optical resonator of the Boeing free-electron laser experiment. Modifications of the electron-beam transport have been included in a previously developed PARMELA model and are shown to reduce dramatically emittance growth in the 180° bend. The new numerically generated electron beam is used in the 3-D FEL simulation code FELEX to calculate expected laser characteristics with the ring optical resonator and the 5-m untapered THUNDER wiggler. Gain, extraction efficiency, and optical power are compared with experimental data. Performance sensitivity to optical cavity misalignments is studied.

47412 (LA-UR–90-2845) **Cumulative beam breakup of the ground-based-free-electron laser.** Chan, K.C.D.; Spalek, G. Los Alamos National Lab., NM (USA). 7 Aug 1990. 15p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9009166–1: 12. international free electron laser conference (FEL-12), Paris (France), 17-21 Sep 1990). Order Number DE90016485. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Strategies employed by the Ground-Based Free Electron Laser system to maintain beam stability in its rf linac against cumulative beam breakup will be described. These strategies include a proper choice of cavity shape and the use of staggered tuning. Simulations show that the growths of effective transverse emittance due to cumulative beam breakup can be limited to 10%. 4 refs., 5 figs., 1 tab.

47413 (LA-UR–90-2888) **High-order optics of multipole magnets.** Walstrom, P.; Neri, F.; Mottershead, T. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9009200–5: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90016438. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a new capability to compute third and fifth order Lie algebraic transfer maps for a family of realistic multipole magnets, including dipoles. The general Hamiltonian is expanded symbolically to arbitrary order. The vector potential off axis, for a given multipole symmetry, is determined from the appropriate magnetic field gradients and their longitudinal derivatives on axis. Subroutines to compute the required gradients are available for Halbach REC quadrupoles, and for general multipoles, with the current distribution on a cylindrical surface specified by a shape function. This function can be supplied by the user, or selected from internal options. Both the reference trajectory, and the map about it are calculated by numerical integration through the general magnetic field, using modular GENMAP software. This allows the calculation of curved reference trajectories in a general dipole magnet, as well as offset reference trajectories needed for misalignment tolerance studies. These new calculational capabilities have been added to the MARYLIE Lie Algebraic beam optics design code.

47414 (LA-UR–90-2919) **Formulas for the Twiss beam parameters for a matched beam at the entrance to a linac.** Swain, G.R. Los Alamos National Lab., NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9009200–4: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90016431. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Formulas for a transversely-matched beam are derived in terms of the r-matrix representation of accelerating and focusing elements in the first period of a linac structure. The formulas predict beam parameters close to the values actually used in tuning the LAMPF 805 MHz linac, and give reasonable-looking results in the other cases for which they have been applied.

47415 (SLAC-PUB–5302) **SSCTRK: A particle tracking code for the SSC.** Ritson, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1990. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515 ;AC02-89ER40486. (SSCL–305). Order Number DE90016682. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

While many indirect methods are available to evaluate dynamic aperture there appears at this time to be no reliable substitute to tracking particles through realistic machine lattices for a number of turns determined by the storage times. Machine lattices are generated by "Monte Carlo" techniques from the expected rms fabrication and survey errors. Any given generated machine can potentially be a lucky or unlucky fluctuation from the average. Therefore simulation to serve as a predictor of future performance must be done for an ensemble of generated machines. Further, several amplitudes and momenta are necessary to predict machine performance. Thus to make Monte Carlo type simulations for the SSC requires very considerable computer resources. Hitherto, it has been assumed that this was not feasible, and alternative indirect methods have been proposed or tried to answer the problem. We reexamined the feasibility of using direct computation. Previous codes have represented lattices by a succession of thin elements separated by bend-drifts. With "kick-drift" configurations, tracking time is linear in the multipole order included, and the code is symplectic. Modern vector processors simultaneously handle a large number of cases in parallel. Combining the efficiencies of kick drift tracking with vector processing, in fact, makes realistic Monte Carlo simulation entirely feasible. SSCTRK uses the above features. It is structured to have a very friendly interface, a very wide latitude of choice for cases to be run in parallel, and, by using pure FORTRAN 77, to interchangeably run on a wide variety of computers. We describe in this paper the program structure operational checks and results achieved.

47416 (SLAC-PUB–5304) **Stability of orbits in nonlinear mechanics for finite but very long times.** Warnock, R.L.; Ruth, R.D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9004230–2: Workshop on nonlinear problems in future particle accelerators, Capri (Italy), 19-25 Apr 1990). Order Number DE90016685. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In various applications of nonlinear mechanics, especially in accelerator design, it would be useful to set bounds on the motion for finite but very long times. Such bounds can be sought with the help of a canonical transformation to new action-angle variables (J, Ψ), such that action J is nearly constant while the angle Ψ advances almost linearly with the time. By examining the change in J during a time T_0 from many initial conditions in the open domain Ω of phase space, one can estimate the change in J during a much larger time T, on any orbit starting in a smaller open domain $\Omega_0 \subset \Omega$. A numerical realization of this idea is described. The canonical transformations, equivalent to close approximations to invariant tori, are constructed by an effective new method in which surfaces are fitted to orbit data. In a first application to a model sextupole lattice in a region of strong nonlinearity, we predict stability of betatron motion in two degrees of freedom for a time comparable to the storage time in a proton storage ring (10^8 turns). 10 refs., 6 figs., 1 tab.

47417 **Unique beam properties of the Stanford superconducting recyclotron.** Smith, T.I. (Stanford Univ., CA (USA). High-Energy Physics Lab.); McAshan, M.S.; Turneaure, J.P.; Lyners, C.M.; Rand, R.E.; Schwettman, H.A. pp. 394-404 of Near zero: New frontiers of physics. Fairbank, J.D.; Deaver, B.S. Jr.; Everitt, C.W.F.; Michelson, P.F. W. H. Freeman and Company, New York, NY (USA) (1988).

In this paper the authors describe the quality and versatility of the accelerator and its recirculation system. They begin by describing three experiments that have been carried out using the SCA. Each of these experiments exploited particular properties of the accelerator, and none of them would have been feasible at any other existing facility. They give a brief description of the linac and the recirculation system, and outline some of the advantages gained in using low temperature techniques.

4303 Auxiliaries and Components

Refer also to citation(s) 47417, 47429, 47762, 47816, 47817, 47822, 47823, 47824, 47997

47418 (BNL–44921) **Magnetic measurements of the NSLS [National Synchrotron Light Source] soft x-ray undulator.** Solomon, L. (Brookhaven National Lab., Upton, NY (USA)); Galayda, J.; Kitamura, M. Brookhaven National Lab., Upton, NY (USA). Jul 1990. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90017629. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Soft X-Ray Undulator Magnet was installed in the X-ray Ring (X1 beam line) at the National Synchrotron Light Source at Brookhaven National Laboratory in June 1988. Prior to its installation extensive magnetic measurements were performed at the NSLS Magnetic Measurements Lab in order to determine the operating values for the end corrector currents, the field quality, and the integrated multipoles associated with the magnet as a function of gap. This report is intended to summarize the results of these measurements. The iron poles are 18mm x 32mm x 86mm, and the Samarium Cobalt permanent magnet blocks are 22mm x 21mm x 110mm. In each of the magnet halves there are 76 slots, 70 of which were filled with two magnets per slot, and 6 of which were left empty (3 each on the upstream and downstream ends of the magnet). These slots were left empty in order to approximate

an infinitely long magnet in the algorithm for the magnet block sorting. The magnet period is 80mm, and the gap range is 31–100mm, with field values of 3500 and 200 Gauss respectively. For this gap range the undulator parameter K, where K = 0.934 B(Tesla) λ(cm), ranges from 2.6 to 0.15. 14 figs., 5 tabs.

47419 (BNL–44959) **A novel non-contact profiler design for measuring synchrotron radiation mirrors.** Lin, Yao (Brookhaven National Lab., Upton, NY (USA)); Takacs, P.Z.; Furenlid, K.; DeBiasse, R.A.; Wang, Run-Wen. Brookhaven National Lab., Upton, NY (USA). Aug 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900756–39: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90017202. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A novel optical profiler is described in this paper for measurement of surface profiles of synchrotron radiation (SR) mirrors. The measurement is based on a combination of an optical heterodyne technique and a precise phase measurement procedure without a reference surface. A Zeeman two-frequency He-Ne laser is employed as the light source. The common-path optical system, which uses a birefringent lens as the beam splitter, minimizes the effects of air turbulence, sample vibration and temperature variation. A special autofocus system allows the profiler to measure the roughness and shape of a sample surface. The optical system is mounted on a large linear air-bearing slide, and is capable of scanning over distances covering the spatial period range from several microns to nearly one meter with a high measurement accuracy. 9 refs., 5 figs.

47420 (BONN-IR–90-18) **Test and construction of the components of a channeling radiation source.** Braun, E. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. May 1990. 53p. (In German). Source: Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

A Channeling-Radiation-Source was built at the 20 MeV linear accelerator (LINAC) at the Physikalisches Institut in Bonn. An account of the development and testing of the components involved is given, which include a 3-axis goniometer with a resolution of 0.1 mrad, as well as a Faraday-cup for 20 MeV electrons. As a result of this work the realization of a Channeling-Radiation-Source at the Bonn 20 MeV LINAC is completed. (orig.).

47421 (FNAL-TM–1675) **Calculation of tune vs amplitudes for the new low beta quadrupoles.** Visnjic, V.V. Fermi National Accelerator Lab., Batavia, IL (USA). 18 Jul 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE90018011. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

I calculate the tune as function of amplitude due to higher multipole errors (in particular the dodecapole) in the new low beta quadrupoles. The results indicate that these multipoles are not expected to give rise to serious problems for the next Tevatron Collide run with two interaction regions.

47422 (LA-UR–90-2667) **Recent advances in RF power generation.** Tallerico, P.J. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-900603–33: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90016615. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper is a review of the progress and methods used in RF generation for particle accelerators. The frequencies of interest are from a few megahertz to 100 GHz, and the powers are for super linear collider applications, but in this case the pulses are short, generally below 1 μs. The very high-power, short-pulse generators are only lightly reviewed here, and for more details the reader should follow the specialized references. Different RF generators excel over various parts of the frequency spectrum. Below 100 MHz solid-state devices and gridded tubes prevail, while the region between 400 MHz and 3 GHz, the cyclotron-resonant devices predominate, and above 250 GHz, Free-Electron Lasers and ubitrons are the most powerful generators. The emphasis for this review is on microwave generation at frequencies below 20 GHz, so the cyclotron-resonant devices are only partially reviewed, while the progress on free-electron laser and ubitrons is not reviewed in this paper. 39 refs., 4 figs.

47423 (LA-UR–90-2740) **A small-bore high-field superconducting quadrupole magnet.** Barlow, D.B. (Los Alamos National Lab., NM (USA)); Kraus, R.H.; Lobb, C.T.; Menzel, M.T.; Walstrom, P.L. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9009200–7: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90016508. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A prototype superconducting quadrupole magnet was designed and built for use in superconducting coupled-cavity linacs where the use of permanent magnets is ruled out by consideration of trapped flux losses. The magnet has a clear bore diameter of 1.8 cm and outside diameter of 11 cm and length of 11 cm. The magnet was operated at a temperature of 4.2 K and obtained a peak quadrupole field gradient of 320 T/m.

47424 (LA-UR–90-2901) **Some new methods of RF control.** Jachim, S.P. Los Alamos National Lab., NM (USA). [1990]. 16p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. Order Number DE90016435. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This presentation will focus on several recent developments at Los Alamos in the area of RF control for accelerators. Included in the discussion will be in-phase/quadrature (I/Q) field control, the application of six-port reflectometers for cavity instrumentation and resonance control, a technique for phase stabilization of critical RF cables, an application of state-variable feedback for field control, and the direct integration of RF and computer-interface hardware using the VXIbus standard. 25 refs., 8 figs.

47425 (NIKHEF-K-DIGEL–1989-8) **Toroidal monitor.** Es, J.T. van; Boes, J.C. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 1989. 16p. (In Dutch). Order Number DE90638354. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The toroidal monitor is a broad band current-to-voltage converter which has been developed on behalf of MEA for the measurement of the beam pulse. (author). 11 figs.

47426 (SAND–90-2287C) **Self-Magnetically Insulated Transmission Line ("SMILE") a new version for the RADLAC II linear accelerator.** Mazarakis, M.G.; Poukey, J.W.; Shope, S.L.; Frost, C.A.; Pankuch, P.J.; Turman, B.N.; Ramirez, J.J.; Prestwich, K.R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009123–1: Linear accelerator conference, Albuquerque, NM (USA), 9-14 Sep 1990). Order Number DE90016896. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present here the SMILE modification of the RADLAC II accelerator which enabled us to produce high quality 12–14 MV, 100 kA beams. It consists of replacing the 40-kA 4-MV beam injector, magnetic vacuum transport and accelerating gaps by a long cathode shank which adds up the voltages of the 8 pulse forming lines. The beam now is produced at the end of the accelerator and is free of all the possible instabilities associated with accelerating gaps and magnetic vacuum transport. Annular beams with $\beta\perp \leq$ 0.1 and radius $r_b \leq 2$ cm are routinely obtained and extracted from a small magnetically immersed foilless electron diode. Results of the experimental evaluation are presented and compared with design parameters and numerical simulation predictions. 6 refs., 7 figs., 1 tab.

47427 (SLAC-PUB–5292) **Cross System Extensions (CSE) experience.** Johnston, T.Y. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9008148–1: SHARE 75, New Orleans, LA (USA), 12-17 Aug 1990). Order Number DE90016686. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Cross System Extension (CSE) provides VM/XA systems with the ability to share minidisks and spool in loosely coupled environment. CSE will also cooperate with the VM/HPO Inter System Facility (ISF) in sharing minidisks between VM/XA and VM/HPO to XA, reliability of CSE, and some operational considerations when running with it.

47428 (UCRL-JC-104776) **Generation of H^- ions in negative ion sources via recombination of H_2^+ and H_3^+ ions incident upon cesium and barium surfaces.** Hiskes, J.R. Lawrence Livermore National Lab., CA (USA). 13 Aug 1990. 7p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. Contract AFOSR-ISSA-89-0039. (CONF-9005194–2: 2. neutral particle beam technical symposium, San Diego, CA (USA), 20-24 May 1990). Order Number DE90016476. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Negative ion source development over the last decade has followed two general approaches: production of hydrogen negative ions by positive ion bombardment of low-work-function surfaces, notably cesium surfaces, and, the direct extraction of negative ions from a hydrogen discharge. The intensive development of this latter cesium-free volume-source system, however, has led to the useful generation of only rather modest current densities. Necessarily limiting the discharge hydrogen-gas-pressure to a value near ten millitorr so as not to impose excessive collisional beam losses in the accelerator column, production of negative ions in the volume source discharge is also limited. The useful H^- current densities achieved to date with these restricted gas pressures has been approximately $10mAcm^{-2}$. But by properly shaping the electron-energy distribution function in both chambers of a tandem-source configuration, and be selecting axial lengths for these chambers in an optimum way, useful current densities in the range of $20–30Acm^{-2}$ should ultimately be achievable even with the constraint of a restricted pressure regime. The need for higher current densities at lower ion-source pressures has motivated the use of cesium or barium electrodes and/or convertors inside the source configuration. This paper discusses the use of these electrodes to generation H^- ions in negative ion sources.

4304 Storage Rings

Refer also to citation(s) 47820, 47840, 47863

47429 **An asymmetric B-factory based on PEP.** Oddone, P. (Lawrence Berkeley Lab., CA (USA)). pp. 237-247 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). DOE Contract AC03-76SF00098. (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper reviews the motivation for building asymmetric B-factories based on storage rings and describes the current LBL/SLAC study to develop such a factory by modifying the PEP storage ring and adding a new low energy (2.5-3 GeV) storage ring. Collisions between the beam of the modified high energy PEP ring and the low energy ring lead to a luminosity of 2×10^{33} cm– 2 sec – 1 at E_{cm} = Y(4s) with currents of 0.8A in each beam. Further increases in current can lead to luminosities close to 10^{34} cm $^{-2}$ sec – 1.

44 INSTRUMENTATION

Refer also to citation(s) 47301, 47303, 47304, 47355

47430 (LBL–26455, pp. 108) **Zero-field NMR.** Jarvie, T.; Matsui, S.; Sun, B.; Takegoshi, K. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

In zero-field NMR, the magnetic field experienced by the sample is cycled between a high value (used for polarization and detection) and zero field, in which spin evolution occurs. This can produce sharp NMR spectra even for polycrystalline or disordered materials and has previously been used to study local symmetry in liquid crystals and correlated motions in hydrogen bonds of solid carboxylic acid dimers. Recent developments involve the application of pulses in zero field, the suppression of zero-frequency peaks, and two-dimensional correlations between high and zero field.

47431 (LBL–26455, pp. 108-111) **SQUID [Superconducting QUantum Interference Device] magnetic resonance.** Chang, J.; Connor, C.; Fan, N.Q. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

In a collaborative project with J. Clarke and E.L. Hahn of MCSD and the University of California at Berkeley Physics Department, two new spectrometers have been designed for the direct detection of low-frequency magnetic resonance using dc Superconducting QUantum Interference Device (SQUID) detectors. Such devices enhance the detection sensitivity by many orders of magnitude. One spectrometer works in continuous-wave mode by detecting dc flux induced by a swept radiofrequency source, whereas the second detects the time-domain signal following a radiofrequency pulse. Using these spectrometers, low-frequency (typically less than 1 MHz) NMR and nuclear quadrupole resonance have been observed for deuterium in solid toluene-d3, boron-11 in glasses, aluminum-27 in crystalline sapphire, magnesium-25 in metallic magnesium, and quantum tunneling of methyl groups at low temperature.

4401 Radiation Instrumentation

Refer also to citation(s) 47408, 47417, 47419, 47759, 47801, 47812, 47813, 47816, 47868, 47918, 47929, 47963, 48035, 48036

47432 (BIR–18, pp. 140-142) **Quality control of dose-area product meters.** Wall, B.F. (National Radiological Protection Board, Chilton (UK)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Dose-area product meters can be fitted to the diaphragm housings of X-ray sets to measure the total exposure of patients during medical radiological examinations. They have an important part to play in quality-assurance programmes since their regular use enables trends in patient exposure to be identified. These trends may indicate deterioration in the efficiency of the image-production system or the need for improved examination techniques and operator training. If results between different hospitals are to be compared, these devices must achieve a certain level of accuracy as well as reproducibility. This paper concentrates on discussing suitable calibration and test procedures for these devices once they have been installed on particular sets of X-ray imaging equipment. Tolerable variations in response are specified when exposure conditions are varied over ranges likely to be met in practice. Experience in using these devices in a large-scale British survey shows that these specifications can be readily met with a commercially available dose-area product meter. (author).

47433 (BIR–18, pp. 149-152) **The need for comparison of diagnostic dosemeters.** Kramer, H.M. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring

methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

One precondition for successfully implementing quality control in diagnostic radiology is that the measuring instruments used are of adequate quality. Among the measuring instruments used for quality control, dosemeters play a predominant role. Therefore it is essential to know the performance characteristics of a suitable dosemeter and to have information on the uncertainties and measurement errors found during acceptance testing. An outline will be given of the requirements on the accuracy of dosemeters. Such requirements have to address the task of the dosemeter and also take into account their technical feasibility. In order to gather information on the performance characteristics of field instruments, a programme for a European intercomparison has been developed which was carried out in 1988. The programme, together with its underlying ideas and its objectives, is presented in this paper. (author).

47434 (BNL–44967) **A 4π tracking TPC magnetic spectrometer for RHIC.** Danby, G. (Brookhaven National Lab., Upton, NY (USA)); Eiseman, S.E.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Van Dijk, J.H.; Lindenbaum, S.J.; Chan, C.S.; Kramer, M.A.; Zhao, K.; BisBrookhaven National Lab., Upton, NY (USA). [1990]. 39p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC02-76CH00016 ;AC02-83ER40107 ;FG05-87ER40309. (CONF-900772–4: 4. workshop on experiments and detectors for a relativistic heavy ion collider, Upton, NY (USA), 2-7 Jul 1990). Order Number DE90017200. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The primary physics objective of the 4π TPC magnetic spectrometer proposal is to search for the Quark-Gluon Plasma. In previous workshops we have discussed what the possible hadronic signatures of such a state of matter would be. Succinctly, the QGP is a direct prediction of non-perturbative QCD. Therefore the question of the existence of this new state of matter bears directly on the validity of non-perturbative QCD. However, since non-perturbative QCD has never been established, it is apparent that what may await us is a host of new phenomena that will go beyond the standard model.

47435 (BONN-IR–90-07) **Construction and test of the electronics for the first triggering stage and the time-of-flight measurement of the SAPHIR detector.** Gehner, A. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Feb 1990. 61p. (In German). Source: Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

The scintillation counter system of the SAPHIR experiment consists of 50 TOF and 12 trigger counters, which are viewed by two photomultipliers, one at each side. To handle the photomultiplier signals an electronic set up was built in order to provide a fast trigger decision for hadronic events. Also the time of flight and the energy loss of the particles can be measured by special CAMAC devices. For test purposes additional trigger options are available. With this array the electronic has been tested successfully with cosmic ray muons and with e^+e^--pairs during first SAPHIR test runs. (orig.).

47436 (CBPF-NF–069/88) **Range to cone length relations for light ions in CR-39.** Gil, L.R.; Marques, A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 12p. Order Number DE90640077. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Curves "range x cone lenght" and "diameter x cone lenght" are calculated for tracks left by low energy light ions in CR-39. The calculations cover ions from helium to iron and are performed for 6.25 N NaOH at 70°C and a standard etching time but can be easily extended to other etching conditions. (author).

47437 (CBPF-NT–002/83) **Bulk etching characteristics of CR-39 track detectors in hydroxide solutions.** Fonseca, E.S. da (Instituto de Radioprotecao e Dosimetria (IRD), Rio de Janeiro, RJ (Brazil)); Knoefel, T.M.J.; Tavares, O.A.P. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1983. 13p. Order Number DE90638555. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A systematic study of the bulk etch rate of CR-39 track detectors in KOH and NaOH aqueous solutions is presented. A number of unirradiated and non-thermally treated CR-39 samples were chemically attacked in KOH and NaOH solutions of concentration and temperature in the range 2-10 N and 50-90°C, respectively. From measurements of the thickness of layers removed as a function of the etching time, the bulk etch rate v_B and the induction time T_o for surface removal were obtained for each etching condition. For both NaOH and KOH solution the activation energy of the process was derived as $E = 0.76 \pm 0.05$ eV. It was observed that the induction time decreases both with increasing normality and temperature of the solution. (author).

47438 (CEGB-TD/B–6316-R89) **A description of the BNL active surface analysis facility.** Tyler, J.W. Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs. Nov 1989. 21p. Order Number DE90638513. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Berkeley Nuclear Laboratories has a responsibility for the assessment of radioactive specimens arising both from post irradiation examination of power reactor components and structures and experimental programmes concerned with fission and activation product transport. Existing analytical facilities have been extended with the commissioning of an active surface analysis instrument (XSAM 800pci, Kratos Analytical). Surface analysis involves the characterisation of the outer few atomic layers of a solid surface/interface whose chemical composition and electronic structure will probably be different from the bulk. The new instrument consists three interconnected chambers positioned in series; comprising of a high vacuum sample introduction chamber, an ultra-high vacuum sample treatment/fracture chamber and an ultra-high vacuum sample analysis chamber. The sample analysis chamber contains the electron, X-ray and ion-guns and the electron and ion detectors necessary for performing X-ray photoelectron spectroscopy, scanning Auger microscopy and secondary-ion mass spectroscopy. The chamber also contains a high stability manipulator to enable submicron imaging of specimens to be achieved and provide sample heating and cooling between - 180 and 600°C. (author).

47439 (CONF-900450–10) **The Gammasphere.** Lee, I-Yang. Oak Ridge National Lab., TN (USA). [1990]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Nuclear structure in the '90's; Oak Ridge, TN (USA); 23-27 Apr 1990. Order Number DE90016849. Source: NTIS, PC A03/MF A01; GPO Dep.

GAMMASPHERE is one of a new generation of gamma ray detector arrays. It consists of 110 Compton-suppressed large volume Ge detectors. The design goal is to achieve high efficiency and peak-to-total value for four to five fold coincidence experiments. Such highfold coincidence capability will provide new physics opportunities in areas such as high spins, transfer reactions, giant resonances, and astrophysics. The design of the detector and shield has been developed through extensive simulation calculations and an "electronic honeycomb" design was chosen. The electronics and computer systems are capable of operating at 50,000 event/sec. The design and development tasks are being carried out at several laboratories in the US. The project is expected to be funded in the fall of 1990. The first experiment is planned in the summer of 1992.

47440 (CTH-RF–72) **Measurements for the energy calibration of the TANSY neutron detectors.** Drozdowicz, K.; Hoek, M.; Aronsson, D. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. May 1990. 80p. Order Number DE90640057. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The report describes measurements performed for the energy calibration of the TANSY neutron detectors (two arrays of 16 detectors each one). The calibration procedure determines four calibration parameters for each detector. Results of the calibration measurements are given and test measurements are presented. A relation of the neutron detector calibration parameters to producer's

data for the photomuliplers is analysed. Also the tests necessary during normal operation of the TANSY neutron spectrometer are elaborated (passive and active tests). A method how to quickly get the calibration parameters for a spare detector in an array of the neutron detectors is included.

47441 (DOE/ER/40310–T1) **Photon detector for MEGA: Progress report, May 1, 1989–July 15, 1990.** Gagliardi, C.A.; Tribble, R.E. Texas A and M Univ., College Station, TX (USA). Cyclotron Inst. [1990]. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40310. Order Number DE90016496. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

During this past August and September, we had beam time at LAMPF for an engineering study of the second prototype cylindrical photon pair spectrometer for MEGA. All of the scintillators in the detector, a total of 40, and 40% of the drift chamber cells were instrumented for this run. The main photon arm activities during the run were to compare event patterns in the chamber to our Monte Carlo generated events, to study the trigger rate and to determine the background rates in the various detector elements. At low beam intensity, the event patterns from the chamber closely resembled those generated from the Monte Carlo. The background rates in the scintillators and the innermost drift chamber layer were close to those anticipated from previous studies. However the background rates in the outer two drift chamber layers were substantially higher than we had expected. This high rate was traced to low energy photons interacting with field and sense wires. The trigger studies during the run have led us to consider alternative strategies including two different first stage triggers and a second stage trigger. The combination of the second stage trigger with either of the two first stage triggers is expected to provide good detection efficiency while keeping the raw trigger rate below that required by the data acquisition system. Detailed discussions of both the background and trigger studies are discussed in this report. Since the run, our work on methods to obtain the z-position in the photon arm drift chambers has continued. Our goal is to obtain the z coordinate to 5 mm FWHM. At this level, the z uncertainty makes a negligible contribution to the overall photon energy resolution and only a small contribution to the angular resolution. We have been studying an option which uses delay lines to provide a direct z determination. The results of our study are discussed in this report.

47442 (INT–234/I) **Experimental study of the conditions for universal calibration curve for the gamma-gamma probes in 2π-geometry.** Gyurcsak, J.; Chau, N.D. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1989. 47p. (In Polish). Order Number DE90640121. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We present the results of the measurements performed in order of establishing the possibility of constructing the universal calibration curves for gamma-gamma density probes. It has been proved that the unit λ_p, in which the source-detector distance should be expressed, has the character of a mean free path of the photons forming the high-energetic part of the spectrum. 8 refs., 12 figs., 7 tabs. (author).

47443 (IPEN-PUB–227) **Results of solid state nuclear track detector technique application in radon detection, by alpha particles tracks, for uranium prospecting in Caetite (BA-Brazil).** Moraes, M.A.P.V. de; Khouri, M.T.F.C. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Nov 1988. 12p. (In Portuguese). Order Number DE90640053. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The solid state nuclear track detector technique has been used in radon detection, by alpha particles tracks for uranium prospecting on the ground in Caetite city (Bahia-Brazil). The sensitive film to alpha particles used were CA 8015 exposed during 15 days and the results of three anomalies of this region are showed in a form of maps, made with the density of tracks obtained, and were compared with scintillation counter measurements. The technique showed to be simple and an effective auxiliary for the prospection of uranium ore bodies. The initial uranium exploration costs can be reduced by using this technique. (author).

47444 (IPEN-PUB–228) **Solid state nuclear track detectors kit for the use in teaching.** Khouri, M.T.F.C.; Koskinas, M.F. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Nov 1988. 8p. (In Portuguese). Order Number DE90640122. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The kit intends to improve the possibilities in performing experiments of Nuclear Physics in Modern Physics laboratories of Physics Course introducing the solid state nuclear track detectors. In these materials the passage of heavily ionizing nuclear particles creates paths (tracks) that may be revealed and made visible in an optical microscope. By the help of the kit several experiments and/or demonstrations may be performed. The kit contains solid state nuclear track detectors unirradiated and irradiated, irradiated etched and unetched sheets: an alpha source of ^{241}Am and an instrution text with photomicrographs. To use the kit the laboratory must have an ordinary optical microscope. (author).

47445 (ITEF–69-89) **Operations with FORTRAN dynamic memory: the ZEBRA system and its predecessors.** Illarionova, N.S.; Savitskij, M.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 22p. (In Russian). Order Number DE90640078. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A comparative review of the most popular programs in FORTRAN used for data processing in high energy physics, is presented. The system of dynamic memory ZEBRA developed in CERN for ES computers is described. The ZEBRA system can be used for any applications which require manipulations with considerable volumes of data with nontrivial internal bonds. The possibility of using the ZEBRA system when developing the systems of data acquisition operating in real time is envisaged. 6 refs.; 5 figs.

47446 (JINR–13-89-117) **Laser spectroscopy of atomic beams of short-lived nuclei.** Solnyshkin, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 16p. (In Russian). Order Number DE90640060. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A possibility of performing laser-nuclear-spectroscopic experiments at qualitatively new level aimed to solve the second-glass current problem and to search T-non invariant effects in the beta-decay of atomic nuclei is discussed. The question of the increase in efficiency of the experiments, aimed to study the main characteristics of nuclei, far from the beta-stability, by means of the laser spectroscopy methods is considered. 147 refs.; 5 figs.; 1 tab.

47447 (JINR–13-89-155) **A set-up for μSR-investigations with a gaseous target without walls.** Bin'ko, G.F. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Grebenev, V.N.; Gurov, Yu.B. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 6p. (In Russian). Order Number DE90640123. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The experimental set-up for μSR-investigations is presented. It follows one to use targets of large sizes. The main part of the installation is a gaseous target of 200x300 mm dimensions. Two solid state detectors (silicon) are located inside the target to register the muon stops in the gas. It is shown that this method has a high efficiency and allows one to practically eliminate the yield from muon stops in the target walls. 3 refs.; 4 figs.; 1 tab.

47448 (JINR-R–1-89-119) **Streamer chamber magnetic spectrometer in the study of the interactions with high-p_t secondaries.** Bannikov, A.V. (and others); Bohm, J.; Vertogradov, L.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 15p. (In Russian). Order Number DE90640079. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The apparatus, which triggers the RISK spectrometer (streamer chamber the magnetic field) on the events containing charged secondary particle with transverse momentum above 1 GeV/c, has been assembled. The main detectors, exploited in this trigger, are three multi-wire proportional chambers. The selection of the investigated interactions is performed using the matrices of coincidences between the hits in the proportional chamber signal planes. The trigger delay time is $\approx 0.4\mu s$ and the background part of all events,

registrated with streamer chamber, is not higher than ≈ 50%. 17 refs.; 8 figs.; 1 tab.

47449 (JINR-R–15-89-107) **On the role of non-stationary conduction relaxation in the ionizing particle tracks.** Tsyganov, Yu.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1989. 6p. (In Russian). Order Number DE90640059. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Conditions for local electrical field occurrence at the metal-semiconductor boundary under heavy charged particle detection by a semiconductor detector are investigated. Behaviour of non-equilibrium electron-hole plasma in the vicinity of drift rate carrier saturation is simulated. Calculations for ionization constant effective values are performed. Difference of charge multiplication occurrence conditions for ^{4}He, ^{20}Ne, ^{40}Ar, ^{64}Zn, ^{132}Xe ions conditioned by track geometry and ionization density are shown. A conclusion is drawn concerning the dependence of avalanche occurrence conditions on the technological features of creating metal-semiconductor transitions. 8 refs.; 6 figs.

47450 (SIS–1990:5) **Acceptance testing of photographic film dosemeters.** Woehni, T.; Ganes, H. Statens Inst. for Straalehygiene, Oslo (Norway). 1990. 15p. (In Norwegian). Order Number DE90640054. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The reports describes a system for acceptance testing of photographic film dosemeters in customary use in personal dosimetry. The system comprises a test of some of the fundamental dosimetric properties of the film. The acceptance test will be performed in connection with the semi-annual purchases of dosemeter film to the National Institute of Radiation Hygiene. The test program comprises both constancy tests and absolute requirements. The latter refer mainly to ISO 1757 - Personal photographic dosemeters. 2 refs.

47451 (SLAC-PUB–5305) **The pad readout electronics of the SLD Warm Iron Calorimeter.** Burrows, P.N. (Massachusetts Inst. of Tech., Cambridge, MA (USA)); Busza, W.; Cartwright, S.L.; Friedman, J.I.; Fuess, S.; Gonzalez, S.; Hansl-Kozanecka, T.; Kendall, H.W.; Lath, A.; Lyons, T.; Osborne, L.S.; Rosenson, L.; Schneekloth, U.; Taylor, F.E.; VeStanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515 ;AC02-76ER03069. (CONF-900626–1: 2. international conference on advanced technology and particle physics, Como (Italy), 11-15 Jun 1990). Order Number DE90016679. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The design of the pad readout electronics of the Warm Iron Calorimeter for the SLD detector at SLAC, consisting of about 9000 analog channels, is described. Results of various tests performed during the construction, installation and commissioning of the electronics mounted on the detector are presented. 10 refs., 12 figs.

47452 (SLAC-TN–87-3-Rev.) **Producing EGS4 shower displays with the Unified Graphics System: Revision.** Cowan, R.F. (Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Nuclear Science); Nelson, W.R. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 16 Aug 1990. 57p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE90017027. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The EGS4 Code System has been coupled with the SLAC Unified Graphics System in such a manner as to provide a means for displaying showers on UGS77-supported devices. This is most easily accomplished by attaching an auxiliary subprogram package (SHOWGRAF) to existing EGS4 User Codes and making use of a graphics display or a post-processor code called EGS4PL. SHOWGRAF may be used to create shower displays directly on interactive IBM 5080 color display devices, supporting three-dimensional rotations, translations, and zoom features, and providing illustration of particle types and energies by color and/or intensity. Alternatively, SHOWGRAF may be used to record a two-dimensional projection of the shower in a device-independent graphics file. The EGS4PL post-processor may then be used to convert this file into device-dependent graphics code for any UGS77-supported device. Options exist within EGS4PL that allow for two-dimensional translations and zoom, for creating line structure to indicate particle types and energies, and for optional display of particles by type. All of this is facilitated by means of the command processor EGS4PL EXEC together with new options (5080 and PDEV) with the standard EGS4IN EXEC routine for running EGS4 interactively under VM/SP. 6 refs.

47453 **Multiple channel programmable coincidence counter.** Arnone, G.J. To Dept. of Energy, Washington, DC (USA). USA Patent 4,920,271/A/. 24 Apr 1990. Filed date 27 Feb 1989. USA Patent Application 7-315,871. Int. Cl. G01T 3/00. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a programmable digital coincidence counter having multiple channels and featuring minimal dead time. Neutron detectors supply electrical pulses to a synchronizing circuit which in turn inputs derandomized pulses to an adding circuit. A random access memory circuit connected as a programmable length shift register receives and shifts the sum of the pulses, and outputs to a serializer. A counter is input by the adding circuit and downcounted by the seralizer, one pulse at a time. The decoded contents of the counter after each decrement is output to scalers.

4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

47454 (LA–11706-MS) **Radiation-induced noise in charge-coupled device (CCD) and charge-injection device (CID) imagers.** Yates, G.J. (Los Alamos National Lab., NM (USA)); Turko, B.T. Los Alamos National Lab., NM (USA). Aug 1990. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90016724. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Measurements of radiation sensitivity for interline transfer charge-coupled devices (CCDs) and charge-injection devices (CIDs) from irradiation with high-energy photons (^{60}Co gammas and 3-to 5-MeV end-point Bremsstrahlung) and 14-MeV neutrons are presented to establish imager susceptibility in such environments. Results from electric 'clearing' techniques designed for quick (≈300μs for the CCDs and ≈10μs for CIDs) removal (or dumping) of radiation-induced charge from prompt sources are discussed. Application of the techniques coupled with long (microsecond to millisecond) persistence radiation-to-light converters for image retention is described. Typical data illustrating the effectiveness of charge 'clearing' in removal of radiation noise are included for nanosecond duration pulsed x-ray/γ-ray doses (50 millirad to 5-rad range) and microsecond duration neutron fluences approaching 10^{8} n/cm^{2}. 10 refs., 16 figs., 4 tabs.

4404 Well Logging Instrumentation

47455 (BHR–44) **A model for the epithermal neutron porosity tool.** Oelgaard, P.L. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Mar 1988. 25p. Order Number DE90638573. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A theoretical model is developed for the epithermal neutron porosity tool. It is based on three-group diffusion-theory. All neutron groups are in the fast neutron region, and the lowest energy group is that in which the neutrons are the detected by the detector. The model is one-dimensional, and it assumes an Am-Be point source. In order to investigate the importance of the various design parameters the model has been used for parameter studies. The parameters considered were: Type of matrix material, source-detector distance, active detector length and energy range of the detected neutrons. Calibration curves were calculated both for water-saturated formations and for formations with constant matrix density. In the latter case various density values were considered. The studies revealed that the most important design parameter is the source-detector distance. The model was compared with available, experimental data. While it was possible to obtain reasonable agreement between measurements and calculations for a source-detector distance of 28.5 cm, this values does not agree with the source-detector distance of 40 cm given in literature. Thus further investigations are needed. (author).

47456 (BHR–45) **Processing of logging data from nuclear tools.** Oelgaard, P.L.; Petersen, R. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Jul 1988. 55p. Order Number DE90638574. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

When raw data, e.g. counts or count rates, have been obtained with nuclear logging tools, they have to be processed in order to yield the desired formation properties. Little information is available on this processing. However, it is necessary to understand the processing procedure in order to be able to evaluate its physical correctness, and to understand which corrections are involved. For this reason an analysis has been performed of two sets of field data obtained with neutron porosity and gamma density tools and one data set obtained with a pulsed-neutron capture-gamma tool. Through this analysis it is believed that full insight in the processing of data from the neutron porosity and the gamma density tools has been achieved. The same is not quite the case for the pulsed neutron capture-gamma tool, possibly due to lack of the necessary data. The analysis has also revealed doubt about the physical correctness of some of the features of the processing procedure. (author).

47457 (BHR–48) **On the use of nuclear logging tools for the determination of the type of geologic formation.** Oelgaard, P.L. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Apr 1989. 32p. Order Number DE90638575. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The result deals with logging methods for the determination of formation types. Initially a review of geologic formations of oil/gas relevance and their composition is given. The natural radioactive elements and their occurrence in ordinary geologic formations are discussed. The integral natural gamma tool is reviewed and a theoretical method for normalising its measurements to a reference geometry is developed. It agrees well with usual methods, but takes more variables into account. The use of the signal of the natural gamma tool to distinguish between limestone and sandstone/shale is discussed. The well-known method for identifying gas-containing layers is demonstrated and its use to identify shale is mentioned. A new approach for identification of shale layers and determination of their clay/sand content is outlined. Finally other methods for identifying geologic layers are briefly discussed. (author).

47458 (BHR–51) **Spectral gamma calculations by use of diffusion theory.** Oelgaard, P.L. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Mar 1989. 21p. (CONF-8903165–: Reactor physics calculations in the Nordic countries, Oslo (Norway), 9-10 Mar 1989). Order Number DE90638576. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In connection with the development of a theoretical model for a gamma density tool it was investigated whether multigroup diffusion theory could be used for such a model. The geometry considered was that of a gamma point source in an infinite, homogeneous medium and a point detector in a distance R from the source. The number of neutron groups was 15. The investigation revealed that if an extra transport correction - in addition to that used for neutrons - was introduced in the highest energy group, good agreement could be obtained with moments calculations for the same geometry. This is true elements up to calcium for muR values between 4 and 10 and for gamma energies between 0.5 and 2 MeV. From this theoretical approach a model for the gamma density tool was developed. It agrees reasonable well with calibration curves for such tools. In addition it can take into account the effect of the formation composition. This paper was presented at the meeting on "Reactor Physics Calculations in the Nordic Countries", Oslo, Mar. 9 to 10, 1989. (author).

47459 (BHR–53) **Interpretation of borehole logging data by use of theoretical models for the nuclear probes used.** Oelgaard, P.L.; Petersen, R. Technical Univ. of Denmark, Lyngby (Denmark). Dept. of Electrophysics. Jun 1989. 48p. Order Number DE90638577. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The report describes the development of a log interpretation programme, based on logs from 4 nuclear tools. For each of these tools a theoretical model is developed. The model of the neutron porosity tool is based on one-dimensional, 3 group diffusion theory, that of the gamma density tool is based one-dimensional, 5 group modified diffusion theory, that of the pulsed-neutron, capture-gamma tool is based on one-dimensional, Fermi-age theory and that of the natural gamma tool on 2 or 3 dimensional numerical integration and the use of build-up factors. The 4 models are incorporated into a computer programme NULIP. This programme uses as input the experimental data of the 4 tools of each depth value. From this input the programme calculates the water/oil, the gas and the matrix volume fraction as a function of depth. Also the volume fraction of clay and sand of shale layers may be obtained. The computation is performed by use of interation and the computing time is about 6 sec for each depth value. An example of the use of the programme on actual field data is presented. The results look quite promising. (author) 19 refs.

4405 Thermal Instrumentation

Refer also to citation(s) 47506, 47747, 47748

47460 (SAND–89-2877C) **Intrinsic (?) reference standards.** Reed, R.P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9008134–2: 1990 national conference of standards laboratories (NCSL) symposium and workshop, Washington, DC (USA), 19-23 Aug 1990). Order Number DE90015714. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The term "Intrinsic" refers to something that is inherent in the nature of a thing. With regard to metrologic references, it usually concerns a characteristic property of a natural material or process. International standard scales, such as those for time, dimension, temperature, voltage, and resistance, are increasingly based on intrinsic natural properties rather than on physical artifacts. The objective is to provide accurate and reliable fiducials that are themselves reproducible independent of place, time, or observer. A distinction must be made, however, between intrinsic properties on which measurement scales are based and physical realizations of particular values of those intrinsic properties in actual reference devices used for practical calibration. Ideally, intrinsic references are not subject to calibration as they represent quantities that are exact by definition. It is sometimes asserted, for example, that such references do not require calibration traceability to a national laboratory. But, it must not be casually assumed that a calibration device that employs a class of natural phenomenon does, in fact, necessarily impose the standardized value on a calibration subject. This paper considers some of the problems associated with the practical use of so-called intrinsic standard references in industrial measurement practice. In particular, distinctions between validation, qualification, and calibration are discussed in relation to intrinsic reference standards and measurement quality assurance. 13 refs.

47461 (SAND–89-2878C) **Traceability: The golden calf (revisited).** Reed, R.P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9008134–1: 1990 national conference of standards laboratories (NCSL) symposium and workshop, Washington, DC (USA), 19-23 Aug 1990). Order Number DE90015716. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ancient religious symbol of the golden calf has become a present day metaphor for a tangible but specious object that diverts the attention from an intangible, authentic, and crucial entity that it purports to represent. Peter Stein, measurement guru, for several years (1962 et seq.) has noted that calibration traceability has taken on the character of a "Golden Calf." He has cautioned that with the present day emphasis on formal quality assurance in measurement, calibration traceability as a primary attestation of accuracy can be disproportionately emphasized to the detriment of actual measurement accuracy. This seemingly paradoxical claim is well-founded as illustrated by many examples where the more important issues of measurement qualification, validation, system characterization, and transient correction are recognized as affecting end accuracy much more critically than usual calibration errors. This paper extends Stein's areas of concern and reviews several practical examples where instrument errors of the magnitude typically revealed in standards laboratory calibration are dwarfed by

the more generally consequential measurement errors of misapplication and naive reliance on highly accurate laboratory calibration of component instruments. The purpose of the paper is not to denigrate calibration nor its traceability. Rather, it is to caution that experimenters, standards and specifications writers, calibration laboratories, and measurement quality auditors must recognize these two important aspects of quality assurance as merely a partial, and certainly not a predominant, tool for the assurance of accuracy and quality in measurement. 12 refs., 1 figs.

4406 Optical Instrumentation

Refer also to citation(s) 46618, 47468, 47469, 47753

47462 (LA-UR–90-2915) **An imaging x-ray microscope using a laser plasma source and a Schwarzchild objective.** Pew, H.K.; Stradling, G.L. Los Alamos National Lab., NM (USA). [1990]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9009235–1: x-ray microscopy conference, London (UK), 3-7 Sep 1990). Order Number DE90016432. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents some design considerations for an imaging x-ray microscope to be used in the "water window" region of the spectrum. The usefulness of such an instrument is discussed. The suitability of current soft x-ray sources and optics are discussed, and the selection of a laser plasma source and a multilayer coated Schwarzchild objective is justified. Also, problems associated with the production of figured multilayer coatings for the "water window" region are discussed. 2 refs.

47463 (UCRL-JC–104336) **A new method for doing flat-field intensity calibrations of multiplexed ITT streak cameras.** Hugenberg, K.F. Lawrence Livermore National Lab., CA (USA). 18 Jun 1990. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900756–37: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90016475. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The flat-field intensity calibrations of ITT downhole streak cameras were previously done with a bandpass filtered flashlamp/integrating sphere combination. However, this system had several problems when characterizing ITT streak cameras that were spatially multiplexed. The main problem, simply stated, was that there was excessive charge build-up on the phosphor screen of the microchannel plate image intensifier (MCPII) before the sweep of the streak camera started. Consequently, the swept CCD image has as many as twenty rows of saturated pixels. In addition, contamination or charge spillover into other rows of the CCD readout became an issue. This article outlines a better approach for doing flat-field calibrations which avoids the CCD saturation problem. 3 refs., 8 figs.

47464 Phase correction system for automatic focusing of synthetic aperture radar. Eichel, P.H.; Ghiglia, D.C.; Jakowatz, C.V. Jr. To Dept. of Energy, Washington, DC (USA). USA Patent 4,924,229/A/. 8 May 1990. Filed date 14 Sep 1989. USA Patent Application 7-407,088. Int. Cl. G01S 13/90. 16p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a phase gradient autofocus system for use in synthetic aperture imaging that accurately compensates for arbitrary phase errors in each imaged frame by locating highlighted areas and determining the phase disturbance or image spread associated with each of these highlight areas. An estimate of the image spread for each highlighted area in a line in the case of one dimensional processing or in a sector, in the case of two-dimensional processing, is determined. The phase error is determined using phase gradient processing. The phase error is then removed from the uncorrected image and the process is iteratively performed to substantially eliminate phase errors which can degrade the image.

47465 Online capacitive densitometer. Porges, K.G. To Dept. of Energy, Washington, DC (USA). USA Patent 4,899,101/A/. 6 Feb 1990. Filed date 21 Jan 1989. USA Patent Application 7-146,509. Int. Cl. G01R 27/26. 10p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an apparatus for measuring fluid density of mixed phase fluid flow. The apparatus employs capacitive sensing of the mixed phased flow combined with means for uniformizing the electric field between the capacitor plates to account for flow line geometry. From measurement of fluid density, the solids feedrate can be ascertained.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 46784

47466 (Juel–2355) **On the operating experience of the Doppler Sodar system at the Forschungszentrum Juelich.** Adiga, B.B.; Zauner, G. Forschungszentrum Juelich GmbH (Germany, F.R.). Abt. Sicherheit und Strahlenschutz. Apr 1990. 48p. Order Number DE90519860. Source: NTIS (US Sales Only), PC A03/MF A01.

In this report the description and the operating principles of the Doppler Sodar at the KFA are briefly described and outputs from the routine operation of the Sodar are compared with the concurrently measured data on the 120 m high KFA meteorological tower. Three sets of data, varying from periods of ten days to 18 days, are used for the comparison. (orig.).

4408 Miscellaneous Instrumentation

Refer also to citation(s) 46381, 47288, 47295, 47296, 47361, 47401, 47483, 47539, 48066

47467 (DOE/CE/15401–T8) **A miniature inexpensive, oxygen sensing element: Quarterly report, April 30, 1990–July 31, 1990.** Arenz, R.W. CeramPhysics, Inc., Westerville, OH (USA). 31 Jul 1990. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-88CE15401. Order Number DE90014080. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is a progress report by: Ceramphysics, Inc. on the design, fabrication and testing of a miniature, inexpensive, oxygen sensing element. Four tasks are discussed. The first is the choice of ceramics, development of a sealing technique and the design of a heating element; the second is preliminary fabrication; the third the testing of prototypes and final fabrication; and the fourth is the preparation of the final report. 2 figs. (FSD)

47468 (DOE/ER/13600–T1) **Holographic rugate structures for x-ray optics applications: Final report.** Jannson, T.; Savant, G. Physical Optics Corp., Torrance, CA (USA). 19 Mar 1990. 160p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-86ER13600. Order Number DE90017103. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Physical Optics Corporation (POC) has proposed and investigated a novel approach to x-ray optics during this DOE-sponsored three-year program, based on our well-established technologies in volume holography and holographic materials. With these technologies, a majority of conventional XUV optical elements, such as uniform and nonuniform gratings/multilayers, lenses, slanted (non-Snellian) mirrors, Fresnel zone-plates, concentrators/collimators, beam splitters, Fabry-Perot etalons, and binary optical elements, can be fabricated using a unified, low cost process. Furthermore, volume holography offer nonconventional optical elements, such as x-ray holographic optical elements (HOEs) with any desirable wavefront formation characteristics and multiple gratings multiplexed in the same volume to perform different operations for different wavelengths, that are difficult or even impossible to produce with the existing technologies.

47469 (DOE/ER/13600–T3) **Holographic rugate structures for x-ray optics applications: Phase 1, Final report.** Physical Optics Corp., Torrance, CA (USA). Dec 1987. 146p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-86ER13600. Order Number DE90017220. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

A new approach to x-ray optics has been proposed by Physical Optics Corporation (POC) based on single-step holographic fabrication of highly-efficient x-ray diffraction elements. These elements

include holographic gratings and mirrors, slanted (non-Snellian) mirrors, uniform and chirped gratings, holographic optical elements (HOEs), lenses and beam splitters, all of which have been investigated in our Phase 1 research program. They have successfully demonstrated the proof of concept of POC's holographic techniques. In our approach, the holographic recording of the interference patterns produced by two (or more) coherent electromagnetic waves is used to create the desired transmission and reflection Bragg holographic structures which can perform various nonconventional operations in the XUV region (soft-x-ray and EUV, from 1 to 100 nm). The proposed XUV high-efficiency holographic structures can be also be applied to more conventional operations such as laser mirroring, collimating, focusing and wavelength dispersion with extremely high resolving power (>10,000,000). Their multi-functional capability makes them competitive to a majority of conventional XUV optical elements including absorptive multilayers, Fresnel zone-plates, grazing-optics imaging mirrors (and collimators), multi-layer Fabry-Perot resonators, uniform and nonuniform surface gratings and binary optical elements.

47470 (LBL–26455, pp. 26) **The design of a computer image system for simulation and processing of TEM images: Hardware and software.** Kilaas, R.; O'Keefe, M.A. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

With images being the central theme in both simulation and processing, the traditional computer setup of a text terminal connected to a heavily used mainframe computer is turning out not to be an optimum choice for these types of applications. Breakthroughs in computer technology are produced far less expensive setups that can rival the turnaround time of their bigger siblings and provide a level of interaction not previously possible. The process of designing an integrated environment is, however, complicated by incompatible hardware and software. In an effort to guide anyone desiring to acquire their own workstation for simulation and processing of TEM images, two systems are discussed. One system has been designed with performance in mind; the other system designed for low cost. Both hardware and software components are discussed, with emphasis on optimum matching of each to the other.

47471 (PNL-SA–17711) **Multiple-sector isotope-ratio mass spectrometer design for high transmission efficiency.** Stoffel, J.J. (Pacific Northwest Lab., Richland, WA (USA)); Laue, H.J. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 25p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9006241–5: 38. ASMS conference on mass spectrometry and allied topics, Tucson, AZ (USA), 4-8 Jun 1990). Order Number DE90016555. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The design of multiple-sector isotope-ratio mass spectrometers has been investigated for the purpose of improving ion transmission efficiency while maintaining high abundance sensitivity. Various magnet geometries with normal and non-normal field boundaries were examined. The most favorable geometry found for tandem 90°- deflection magnets has boundaries 17° off-normal and drift lengths 1.4 times the radius of deflection. The ion beam is rendered parallel in the vertical plane at the focus of the first magnet and is brought to a stigmatic focus by the second magnet. This geometry provides a 16% increase in mass resolution over normal geometry and gives 100% transmission without the need for intermediate focusing lenses. Complete transmission is also maintained with the addition of a cylindrical electric sector as a third stage for greater abundance sensitivity. 13 refs., 14 figs., 2 tabs.

47472 (POEF-T–3533) **Mobile leak-rate buggy.** Orlett, M.J. Martin Marietta Energy Systems, Inc., Piketon, OH (USA). 25 Jun 1990. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-76OR00001. Order Number DE90015783. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Leak-rating of large equipment at Portsmouth, such as 33-size cells, requires accurately measuring a pressure change of 0.001 psi/hr. In the past, this was done using a pneumatic differential blind transmitter (DBM) located on the cell evacuation header. Leak-rating a 33-size cell by this method took about two hours and tied up the cell evacuation header so that the work requiring the header was delayed. The Chemical Technology Department constructed a mobile leak-rate system based on a very sensitive electronic differential pressure transmitter. This prototype system has been used successfully for about four months by X-333 operators to leak-rate cells. It can detect and rate a mildly leaking cell in as little as five minutes. A leak-rate of less than 0.001 psi/hr can be accurately measured in less than 0.5 hour. This paper describes that system. 3 figs.

47473 (UCRL–102583) **Deposition controlled uniformity of multilayer mirrors.** Jankowski, A.F.; Makowiecki, D.M.; Patterson, R.G.; McKernan, M.A.; Foreman, R.J. Lawrence Livermore National Lab., CA (USA). Jun 1990. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900756–38: SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90015906. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The widely used physical vapor deposition techniques to produce multilayer x-ray optics with uniform layer pair spacings (<1% variation) over large areas(>10cm x 10 cm) have all been limited by the geometry of the vapor source. Magnetron sputtering sources, geometrically a convolution of point sources in a circular or rectangular array, provide uniformly thick regions of coating only within the boundaries of the erosion track. To maximize uniformity over large regions requires target materials equally as large, proving a costly proposition. Electron beam or molecular beam sources are similarly limited by the size of the melt pool or effusion cell diameter. For ion beam deposition, spatial divergence from typical ion sources results in coating thickness variations of 5% or more for large areas as previously described. To minimize the ultimate expense of designing a necessarily large, single deposition source to provide a small thickness variation (without the use of compensating substrate motion or elaborate shielding over the deposition sources), several small sources arranged in an appropriate array may provide a viable alternative. To this end, the use of linear array of one-inch magnetron sources has proven effective. Material has been deposited within the limitations of 1.5% thickness variation, along the axis of a linear gun array, over 15cm in length. The feasibility of using two linear arrays of magnetron sources is investigated to prepare large area multilayer mirrors with minimal layer pair spacing variations. Such a deposition system also allows for gradually varying the layer pair spacings across the surface of an optic, in a designed manner, which proves useful for focusing applications. 3 refs., 5 figs.

47474 (UCRL-CR–104574) **Design of a triaxial residual stress measurement system using high energy x-ray diffraction: Final report.** Shackelford, J.F.; Brown, B.D.; Park, J.S. Lawrence Livermore National Lab., CA (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016212. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Previous design studies in developing concepts for residual stress measurement in engineering materials have been extended. A pre-prototype energy dispersive x-ray diffraction (EDXRD) system has been fabricated. A 300 kV radiography source is used in conjunction with an intrinsic germanium detector and a MacII/LabVIEW data acquisition system. Specimens up to 25mm equivalent steel thickness (and one meter gross dimensions) can now be evaluated. The pre-prototype system serves as the hard x-ray, bulk stress measurement component of the previously reported hybrid stress measuring system (which would include a traditional multi-angle surface measurement system using soft x-rays). In addition, a detailed study of residual stress analytical equations has been completed and applied to various metallic and ceramic materials. During the grant period, related studies were completed on stress measurement using synchrotron radiation and on a critical review of the residual stress literature. 6 refs., 3 figs.

47475 **Flowmeter for gas-entrained solids flow.** Porges, K.G. To Dept. of Energy, Washington, DC (USA). USA Patent 4,930,356/A/. 5 Jun 1990. Filed date 20 Apr 1989. USA Patent Application 7-341,004. Int. Cl. G01F 1/56. 8p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an apparatus and method for the measurement of solids feedrate in a gas-entrained solids flow conveyance system. The apparatus and method include a vertical duct connecting a source of solids to the gas-entrained flow conveyance system, a control valve positioned in the vertical duct, and a capacitive densitometer positioned along the duct at a location a known distance below the control valved.

47476 Hydrostatic self-aligning axial/torsional mechanism. O'Connor, D.G.; Gerth, H.L. To Dept. of Energy, Washington, DC (USA). USA Patent 4,928,532/A/. 29 May 1990. Filed date 23 May 1989. USA Patent Application 7-355,585. Int. Cl. G01N 3/02. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes an invention directed to a self-aligning axial/torsional loading mechanism for testing the strength of brittle materials which are sensitive to bending moments. Disposed inside the self-aligning loading mechanism is a frictionless hydrostatic ball joint with a flexure ring to accommodate torsional loads through the ball joint.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 46932, 47374, 48055, 48056, 48057

47477 (ORNL/M–1198) **Airlift deployment analysis system life cycle cost analysis.** Truett, L.F. (Oak Ridge National Lab., TN (USA)); Das, S.; Worthington, J.C. Oak Ridge National Lab., TN (USA). Aug 1990. 64p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90016131. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Airlift Deployment Analysis System (ADANS) is an automated system that will provide Headquarters, Military Airlift Command (HQ MAC) with planning, scheduling, and analysis tools for peacetime and contingency airlift operations. This Life Cycle Cost (LCC) analysis identifies cost factors impacting ADANS during its life cycle. This analysis lists exact costs when known and reasonable estimates of other costs. This report states costs in fiscal year (FY) dollars for costs already expended (FY86–FY89) and in FY90 dollars for projected costs. Factors that could have a substantial impact on the ADANS life cycle development and maintenance costs are noted. The development effort will conclude in FY92. This LCC analysis covers a 15-year period from FY86–FY00. The total costs of ADANS is projected to be approximately $60 million. Of this total, about 20% is for development of functional capability, about 9% for development of the cross-cutting subsystems, and about 71% for program and system support. The total Oak Ridge National Laboratory development cost for FY86–FY92 is about $27.5 million; the total cost for HQ MAC is about 32.5 million. 32 tabs.

47478 (PNL-SA–17205) **Millimeter wave transmissometer computer system.** Wiberg, J.D.; Widener, K.B. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 30p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9004223–1: 1. international conference on systems integration, Morristown, NJ (USA), 23-26 Apr 1990). Order Number DE90017191. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A millimeter wave transmissometer has been designed and built by the Pacific Northwest Laboratory in Richland, Washington for the US Army at the Dugway Proving Grounds in Dugway, Utah. This real-time data acquisition and control system is used to test and characterize battlefield obscurants according to the transmittance of electromagnetic radiation in the millimeter wavelengths. It is an advanced five-frequency instrumentation radar system consisting of a transceiver van and a receiver van deployed at opposite sides of a test grid. The transceiver computer systems is the successful integration of a Digital Equipment Corporation (DEC) VAX 8350, multiple VME bus systems with Motorola M68020 processors (one for each radar frequency), an IEEE-488 instrumentation bus, and an Aptec IOC-24 I/O computer. The software development platforms are the VAX 8350 and an IBM PC/AT. A variety of compilers, cross-assemblers, microcode assemblers, and linkers were employed to facilitate development of the system software. Transmittance measurements from each radar are taken forty times per second under control of a VME based M68020.

47479 (PNL-SA–18088) **Force Level Control System Experiment No. 2: Brigade TOC [tactical operations center] information flows, including commander's critical information requirements and the effect of automation on command and control.** Hesser, W.A.; Grinde, R.B. Pacific Northwest Lab., Richland, WA (USA). May 1990. 10p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. (CONF-9005162–2: TIMS/ORSA joint national meeting, Las Vegas, NV (USA), 7-9 May 1990). Order Number DE90016332. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Force Level Control System Experiment No. 2 (FLCS2) was conducted in conjunction with 9th Infantry Division (9ID) Command Post Exercise (CPX) Caber Calm, 11–15 September 1989, at Fort Lewis, Washington. FLCS2 was executed by the Army Development and Employment Agency (ADEA), Fort Lewis, as part of a series of experiments in support of the Army Tactical Command and Control System Experimentation Site (AES). This paper presents the methods employed in the research and includes sample results showing the range and depth of the analysis. 7 figs.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 47122, 47311

47480 (AD-A–222183/6/XAB) **Estimating characteristics of chemical explosions in New England and Eastern Kazakhstan using local and regional seismic data. Final report, October 1988-September 1989.** Kafka, A.L.; Jacobson-Carroll, M.; d'Annolfo, S. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 9 Nov 1989. 21p. (GL-TR–89-0301). Source: NTIS, PC A03/MF A01.

One of the problems associated with monitoring a comprehensive nuclear test ban treaty is that of discrimination between small explosions and earthquakes based on seismic data. Chemical explosions are used routinely in the mining and construction industries in both the United States and the Soviet Union. These chemical explosions usually occur at very shallow depths (a few tens of feet), and probably are all shallower than a few hundred meters. Most nuclear explosions are detonated at depths of less than about one kilometer, and the deepest underground nuclear explosions are a few kilimeters deep. On the other hand, most earthquakes occur deeper in the earth's crust. Thus, accurate estimation of the depths of seismic sources can be helpful in discriminating earthquakes from explosions. During the past several years, the Principal Investigator (PI) for this summer project has been studying the use of short-period Rayleigh waves (Rg) as a depth discriminant for seismic sources in New England.

47481 (LA–11837-MS) **Chemistry of detonation soot II: More diamonds and volatiles.** Greiner, N.R.; Rogers, Y.C.; Spall, W.D. Los Alamos National Lab., NM (USA). May 1990. 9p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. Order Number DE90017237. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Soot samples obtained from detonation of explosive charges were subjected to perchloric acid oxidation. Diamond peaks were confirmed by x-ray diffraction in most of the residues. Untreated soot samples were pyrolyzed and evaluated by gas chromatograph/mass spectrometry; a total of 31 different volatiles were recovered. The volatiles observed in detonation soot are similar to those found in carbon blacks, naphthalene and benzonitrile being the most abundant and frequently observed pyrolysis products. Differences among the volatile components result in a characteristic fingerprint of each soot and may provide insight into energy release and chemical transformations involved in explosive reactions. 11 refs., 1 fig., 3 tabs.

47482 (LA–11903-MS) **Transition state theory applying to the study of reaction processes in detonation.** Tang, Pier K. Los Alamos National Lab., NM (USA). Jul 1990. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36.

Order Number DE90016558. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The presence of a nearly constant process time that characterizes the fast reaction portion found in the detonation of condensed high explosives can be explained by the transition state theory. Through hydrodynamic modeling, we identify that time as the excitation time for the production of an energetic state that can go either forward to achieve decomposition or backward to the original unexcited state. The energetic state is a representation of a nonequilibrium condition that favors the chemical reaction, whereas the unexcited or equilibrium state does not. This process time is determined by matching the experimental interface velocimetry record, and its value is nearly constant over a wide range of conditions. 23 refs., 6 figs.

47483 (MLM–3652(OP)) **Development and application of LEESA (Low Energy Electrostatic Sensitivity Apparatus).** Carlson, R.S. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)); Wood, R.L. EG and G Mound Applied Technologies, Miamisburg, OH (USA). [1990]. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-900792–10: 15. international pyrotechnics seminar, Boulder, CO (USA), 9-13 Jul 1990). Order Number DE90015742. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A precision Low Energy Electrostatic Sensitivity Apparatus (LEESA) was developed in the voltage range 0–3000 volts dc and was employed over a capacitance range of 25–50,000 pF on sensitive, very sensitive, and extremely sensitive pyrotechnic fuels and compositions. Zirconium powder, $Zr/KClO_4$ pyrotechnic, titanium powder, $Ti/KClO_4$ and $TiH_x/KClO_4$ pyrotechnics (x = 0.65, 1.65) and several other sensitive materials were evaluated. LEESA simulates casual human contact with potentially hazardous materials. In operation, a hand-held probe is applied to the sample to discharge the capacitance. As the probe approaches the sample, a spark jumps from the probe tip to the sample when the gap closes to the appropriate distance. This is analagous to a finger or a tool touching a sensitive material during which maneuver a spark jumps to the material. LEESA defines the probability of ignition over a voltage or energy range and is capable of thousands of trials on a test material in the span of a few hours. In addition to evaluating static sensitivity, the effect of electrode polarity, individual differences between operators, test method, humidity, sample size, particle size, capacitance, time constant RC, and voltage versus energy have been determined. The equipment is inexpensive and easy to build and use and is a low risk method because of the small quantities of sensitive material being tested at any one time. The accuracy and precision of the results surpasses that of methods currently in use. 7 refs., 11 figs., 1 tab.

47484 (UCRL-CR–104639) **Very high burn rate propellants: Final report.** Lawrence Livermore National Lab., CA (USA); Teledyne McCormick Selph, Hollister, CA (USA). [1990]. 76p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016865. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Teledyne McCormick Selph has successfully completed the objectives of the program – the formulation, synthesis, and characterization of several cast solid propellants possessing very high burn rates (of the order of several meters per second) and suitable for incorporation as the propelling charge for a variety of modern gun systems of various calibers, and for potential rocket applications. More specifically, the tasks successfully accomplished include: (1) The selection of candidate propellant compositions based upon the practical factors of chemical stability and compatibility, density, heat of formation, availability and cost. (2) Theoretical thermochemical and ballistic evaluation and subsequent downselection. (3) Batch preparation of selected candidates and manufacturing process parameters studies. (4) Experimental determination of safety characteristics and ballistic evaluation (i.e., burn rate determination). (5) Preliminary studies of grain designs and theoretical ballistic performance for gun applications. The results indicate substantial improvement in several current gun systems are achievable by incorporating the technology and propellants developed as a result of this project.

47485 (UCRL-JC–103654) **Correlation between the ultimate elongations of rapidly expanding rings and stretching metal jets.** Gourdin, W.H. Lawrence Livermore National Lab., CA (USA). 1 Aug 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900818–5: International conference on shock wave and high-strain-rate phenomena in materials, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90016482. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The recent work of Duffy and Golaski and Lichtenberger demonstrated that the initial metallurgical condition of a material can significantly affect its performance when used as a shaped-charge liner. Duffy and Golaski showed that the penetration of copper shaped charges increases by 10–20% when the grain size of the liner is reduced from 150 to 25 μm and the uniformity of the microstructure is improved. Lichtenberger confirmed this behavior in liners made from oxygen-free electronic (OFE) grade copper and also showed that the purity of the liner material can produce similar effects. These observations suggest that some characteristic of the liner material itself can be correlated with shaped-charge performance. Such a characteristic, along with a corresponding laboratory test procedure, would be very useful as a means of identifying promising candidate materials prior to the expensive testing of prototype munitions. Lichtenberger has suggested that the"recrystallization temperature" is one such characteristic, and he has successfully demonstrated a correlation with jet behavior. In this paper, I suggest that the ultimate elongation of specimen rings expanded by means of the electromagnetic launch technique is another material characteristic that appears to correlate with the breakup behavior of stretching metal jets. I briefly discuss in general terms why such a correlation may exist and then offer some limited experimental evidence for it.

47486 **Reverse slapper detonator.** Weingart, R.C. To Dept. of Energy, Washington, DC (USA). USA Patent 4,928,595/A/. 29 May 1990. Filed date 27 Apr 1988. USA Patent Application 7-186,527. Int. Cl. F42B 3/12. 6p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a reverse slapper detonator, and methodology related thereto. The detonator is adapted to be driven by a pulse of electric power from an external source. A conductor is disposed along the top, side, and bottom surfaces of a sheetlike insulator. Part of the conductor comprises a bridge, and an aperture is positioned within the conductor, with the bridge and the aperture located on opposite sides of the insulator. A barrel and related explosive charge are positioned adjacent to and in alignment with the aperture, and the bridge is buttressed with a backing layer. When the electric power pulse vaporizes the bridge, a portion of the insulator is propelled through the aperture and barrel, and against the explosive charge, thereby detonating it.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 46660

47487 (AD-A–222530/8/XAB) **Underground-test sensor development. Volume 2. Electric-field sensor development. Technical report.** Bahns, J. Pacific-Sierra Research Corp., Los Angeles, CA (USA). May 1990. 125p. Contract DNA001-86-C-0124. Source: NTIS, PC A06/MF A01.

See also Volume 1, AD-C043 800.

A concept for the nonperturbative measurement of electric fields in a plasma is described. The concept is based on laser-induced fluorescence from Stark-mixed states. This work reviews the electric field measurement concept, the choices of an active medium, and the laser and detector characteristics. A proof-of-principle experiment was set up and executed. The experimental results which demonstrate the feasibility of this technique for source region electro-magnetic pulse measurements are presented.

47488 (GAO/T-RCED–90-33) **GAO's views on DOE's 1991 budget for addressing problems at the nuclear weapons complex.** Fultz, K.O. General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 12p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This statement discusses DOE's 1991 budget request as it relates to cleaning up and modernizing the nuclear weapons complex. This report's testimony focuses on the continuing problems of the complex, DOE's progress in addressing these problems, and important budget issues. In 1989 GAO testified on serious problems at the complex and the staggering cost to address them.

47489 (GAO/T-RCED-90-52) **DOE's management and oversight of the nuclear weapons complex.** Rezendes, V.S. General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 14p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

DOE's nuclear weapons complex is virtually shut-down today due to a multitude of serious environmental, safety, and operational problems. These include deteriorated facilities, contaminated soil and groundwater, and disposal of radioactive waste that has been in temporary storage for decades. This report discusses these ongoing problems, as well as longstanding management problems, recent DOE management and oversight initiatives, and GAO's views on DOE's efforts and implications for the future management of the complex.

47490 (MLM-3640) **Technology Update-90.** Fitzharris, P.A. (ed.). EG and G Mound Applied Technologies, Miamisburg, OH (USA). Jul 1990. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. Order Number DE90016662. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This periodical reviews various research programs and their accomplishments at EGG Mound Laboratories. Topics covered in this issue are: Mound Awarded Role in Product Acceptance; Atmospheric Releases Assessed in Real Time; Robot Performs Plasma Spraying; Workers Protected from Radioactive Materials; Surface Chemistry Affects Pyrotechnic Ignition; and Hazardous Materials Replaced. 9 refs., 24 figs., 1 tab. (FSD)

47491 (UCRL-JC-104541) **Explosion phenomenology in jointed rocks: New insights.** Heuze, F.E.; Butkovich, T.R.; Walton, O.R.; Maddix, D.M. Lawrence Livermore National Lab., CA (USA). Jul 1990. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9010172-2: 61. shock and vibration symposium, Pasadena, CA (USA), 16-18 Oct 1990). Order Number DE90015903. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This article deals with the effects of high-explosive and nuclear explosions in rock masses. We first highlight the strong influence of geological discontinuities, such as joints and faults, on ground motion characteristics. Then, we briefly introduce the Discrete Element method, as a new technique for numerical simulations. It is shown to be far superior to continuum-based approaches, when dealing with the dynamics of discontinuous media such as jointed rocks. Finally, we simulate the ground effects from a generic contained nuclear explosion, which bears some similarity to the SHOAL event in granite. This calculation is intended to emphasize the influence of the near-source geology on the distribution of energy, and on the motion at various azimuths in the medium. 17 refs., 10 figs.

4503 Nuclear Explosion Detection

Refer also to citation(s) 47480, 47487

47492 (AD-A-222133/1/XAB) **Broadband discrimination studies. Technical report Nos. 5-8, 1 October 1979-30 September 1980.** McEvilly, T.V.; Johnson, L.R. California Univ., Berkeley, CA (USA). Seismographic Station. 29 Dec 1980. 77p. Contracts F49620-79-C-0028, ARPA Order-3291. Source: NTIS, PC A05/MF A01.

A seismic array consisting of 9 stations arranged as three nested triangles with minimum spacing of 100 m and maximum spacing of 400 m was used to record the two NTS explosions, LIPTAUER in Yucca Valley on 3 April 1980 and COLWICK on Pahute Mesa on 26 April 1980. The distance of the array from the explosion was 1.9 km for LIPTAUER and 6.0 km for COLWICK. So far our analysis has concentrated on the COLWICK data. Preliminary results show that most of the energy in the first 5 sec of the seismograms is propagating at an azimuth and velocity which are consistent with generation at or very near the explosive source. The spatial coherence decays by a factor of 1/e at distances that range between 400 and 1200 m, depending upon direction and component of motion. In a direction parallel to the wavefront, the vertical and radial components are much more coherent than the transverse component, while all of the components have comparable coherence in a direction perpendicular to the wavefront. Coherence generally decreases as frequency increases. In addition to aiding our interpretation of elastic waves generated by an explosion, these array data should provide useful constraints on the possible mechanisms by which elastic waves can be scattered by inhomogeneities near the surface of the earth.

47493 (AD-A-222187/7/XAB) **Seismic recording in eastern California of the KEARSARGE nuclear test. Environmental research papers, June 1988-September 1989.** Cipar, J.; Taylor, C.; Craig, J. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 6 Nov 1989. 33p. (GL-TR-89-0303). Source: NTIS, PC A03/MF A01.

A temporary ten-station seismic network was operated in eastern California to record the KEARSARGE nuclear test at the Nevada Test Site. Data from 8 three-component, short-period stations and 2 three-component, mid-period stations are presented. Part of the array was arranged as a profile between 150 to 250 km from NTS. At these ranges, the first arrivals are Pn waves refracted along the crust-mantle boundary. The Pn travel times can be modeled by assuming a 32-km thick crust at NTS, which as a 3 deg westward dip beginning approximately 90 km west of the shot point. This model predicts a crustal thickness of 41.8 km at a point 277 km west of the shot point (that is, under the central Sierra Nevada). This model is in good agreement with the models of Eaton and of Pakiser and Brune and contrary to the model of Carder et al and Carder. There still remain significant offsets in the Carder et al NTS travel-time data in the 250 to 270 km and 360 to 390 km distance ranges. Closely-spaced, digitally-recorded observations in those distance ranges are needed to completely resolve the seismic structure of the Sierra Nevada-Basin and Range transition zone.

47494 (AD-A-222289/1/XAB) **VELA program. A twenty-five year review of basic research.** Kerr, A.U. Defense Advanced Research Projects Agency, Arlington, VA (USA). 1985. 984p. Source: NTIS, PC A99/MF E09.

Partial Contents: A Review of Test Ban Research; Underground Nuclear Weapons Testing and Seismology - A Cooperative Effort; Forensic Seismology; Technical Issues Related to Nuclear Test Ban Treaties; VELA Overview: The Early Years of the Seismic Research Program; Explosion/Earthquake Source Theory; Linear Elastic Waveform Modeling in the Inelastic Region of Underground Nuclear Explosions; Seismic Wave Propagation Effects; Development of Theory and Numerical Modeling; In-Situ Paths Strain and Stress Bounds with Application to Desert Alluvium; Seismic Scattering and Lithospheric Heterogeneity; Body Wave Propagation in three-Dimensional Source and Receiver Structure; Instrumentation and Signal Analysis; Regional Seismic Array Program and High Frequency Instrumentation; Signal Analysis: Explosion Seismology; Earthquake or Explosion: Where are We Now; Teleseismic Methods; Regional Methods; and Tools for Seismic Data Analysis and Management for Research and International Data Exchange.

4504 Nuclear and Radiological Warfare

Refer also to citation(s) 47119

4505 Strategic Defense Initiative

47495 (AD-A-222472/3/XAB) **Nonlinear dynamics and control of SDI structural components. Final report, September 1987-February 1990.** Nayfeh, A.H.; Burns, J.A.; Cliff, E.M. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Dept. of Engineering Science and Mechanics. 18 May 1990. 16p. Contract F49620-87-C-0088. Source: NTIS, PC A03/MF A01.

The report summarizes results of experimental and theoretical investigations into the nonlinear response and control of structural elements. Methods for the analysis and design of control procedures applicable to certain nonlinear distributed parameter systems were investigated. Analytical and computational techniques were

developed for evaluating the nonlinear effects on control designs. Bench-type experiments were conducted for validating some of the theoretical results.

47496 (GAO/NSIAD–90-2) **Strategic Defense Initiative program: Extent of foreign participation.** General Accounting Office, Washington, DC (USA). National Security and International Affairs Div. Mar 1990. 34p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report is a review of the extent of foreign contracting in the Strategic Defense Initiative Program. GAO identified 67 foreign contracts valued at $297.1 million, which represents about three percent of total Strategic Defense Initiative contract awards, and 86 foreign subcontracts from U.S. companies totaling $48.4 million. The basis of award for the 67 foreign contracts was more often competitive that sole source, although sole-source awards accounted for a higher dollar amount. The basis of the award by each of the U.S. agencies administering foreign contracts varied. Israel received the largest dollar value of contracts among foreign recipients. DOD and foreign embassy officials said foreign contracts allow the United States not only to share technology with other countries but also benefit from technological developments in those countries.

4506 Chemical and Biological

Refer also to citation(s) 47121

47497 (AD-A–222443/4/XAB) **Department of Defense annual report on chemical warfare and chemical/biological defense research program obligations for the period 1 October 1988 through 30 September 1989.** Office of the Under Secretary of Defense for Research and Engineering, Washington, DC (USA). 30 Sep 1989. 76p. Source: NTIS, PC A05/MF A01.

The Contamination Control System Analysis continued into Phase IV, which, examines the flow of contamination information to determine the most mission effective solution. Toxicology testing is continuing on the primary uptake simulant, leading to approval for human use. The Multiman Intermittent Cooling System completed successfully Qualitative Operational Tests. The system provides filtered cooled air to personnel during rest periods from heavy work in chemical protective clothing. A study was performed to determine the effectiveness of various communication devices for personnel in chemical clothing working in a flight line noise environment. Advanced development test started on a detection device which uses the surface acoustic wave principle. The detector will be used in aircraft cockpits and collective shelters. A study was performed to determine the effectiveness of a mask fit test device in improving personal protection.

54 ENVIRONMENTAL SCIENCES

47498 (CNIC–00301) **Radiological environmental quality assessment of the nuclear industry in China over the past 30 years.** Pan Ziqiang (Deptartment of Safety, Protection, Environment and Health, China National Nuclear Corporation, Beijing, BJ (China)); Wang Zhibo; Chen Zhuzhou; Zhang Yongxing; Xei Jianlun. China Nuclear Information Centre, Beijing, BJ (China). Mar 1989. 24p. (In Chinese). (DSPHN–0002). Order Number DE90638284. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The radiological evaluation of nuclear industry was begun in 1981. Up to the extent of 80 km from each facility, the investigation of population, crop distribution and food spectrum have been made. Meteorological, hydrological and geological data as well as effluents and environment monitoring data have been obtained and analyzed. All the calculation was performed through Y3001 computer code. According to the calculation results, the effective dose equivalents to all the critical groups near the nuclear facilities are below the dose limits. About 80% of the critical groups received doses are less than 1/10 of the doses caused by natural radiation (3 mSv · a^{-1}). The total annual average collective effective dose equivalent resulted from the whole nuclear industry is 23 man · Sv/a, which is less than 0.01% of natural radiation dose and far below the detriment resulted from non-nuclear industries or other human activities. According to the nuclear industry planning of China, in the year of 2000, it is estimated that the total annual collective effective dose equivalent resulted from the whole nuclear industry is 59 man · Sv.

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 46391, 46394, 46395, 46477, 46479, 46668, 46718, 46753, 46874, 46916, 46993, 47003, 47026, 47055, 47113, 47114, 47280, 47353, 47354, 47355, 47371, 47372, 47375, 47490, 47555, 47574, 47575, 47576, 47577, 47580, 47584, 47585, 47588, 47590, 47595, 47603, 47604, 47611, 47613, 47697, 47702, 47744

47499 (BNL–44104) **[Greenhouse gases and national energy options]: Foreign trip report, April 7–14, 1990.** Hamilton, L.D. Brookhaven National Lab., Upton, NY (USA). 18 Apr 1990. 52p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract AC02-76CH00016. Order Number DE90016748. Source: NTIS, PC A04/MF A01 - OSTI.

Dr. L. D. Hamilton and Mr. G. A. Goldstein attended the 1st Workshop International Energy Agency (IEA), Energy Technology Systems Analysis Programme (ETSAP) Annex IV, Greenhouse Gases and National Energy Options: Technologies and Costs for Reducing Emissions of Greenhouse Gases, Energy Study Center, Netherlands Energy Research Foundation, Petten, The Netherlands, April 9–11, 1990. As global interest in evaluating the impacts of policies for reducing emissions of greenhouse gases at national and international levels increases, the IEA ETSAP group could be in a good position to make a direct contribution. The group, applying the MARKAL energy/environment linear program as its primary modeling tool, was a forum for international collaboration on energy issues for over a decade. The purpose of this trip was to reassert US DOE interest in the activities of ETSAP Annex IV; obtain knowledge as to the current status of various national efforts; demonstrate the PC version of the US energy system the Market Allocation (MARKAL) model, together with the Brookhaven developed MARKAL Users Support System (MUSS), as a tool to improve greatly MARKAL usability for upcoming analysis and by non-IEA countries, especially developing countries; and participate in establishing a Work Plan for Annex IV.

47500 (CONF-890525–) **Global and regional environmental atmospheric chemistry.** Newman, L. (Brookhaven National Lab., Upton, NY (USA)); Wang, Wenxing; Kiang, C.S. Brookhaven National Lab., Upton, NY (USA). Aug 1990. 773p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. From International conference on global and regional environmental atmospheric chemistry; Beijing (China); 3-10 May 1989. Order Number DE90016693. Source: NTIS, PC A99/MF A01 - OSTI; GPO Dep.

More than two hundred fifty scientists from eighteen different countries attended the first International Conference on Global and Regional Environmental Atmospheric Chemistry in the Science Hall of Friendship Hotel at Beijing, May 3–10, 1989. This volume documents the proceedings of this historical event. Following the meeting, some 173 papers were submitted for this publication. When follow up papers were not submitted the original abstract is presented. Also included are abstracts of the posters presented by the Chinese participants who could not be accommodated during the more formal sessions. We might add that this more informal session was particularly useful for the exchange of ideas and information between east and west. Indeed, the conference overall certainly provided an enthusiastic platform for interactions among scientists from around the world. It is our hope that these proceedings will serve as a vehicle to further enhance collaboration for joint studies of the changes in the global environment.

47501 (CONF-9005261–1) **Short-rotation woody crop opportunities to mitigate carbon dioxide buildup.** Wright, L.L.; Graham, R.L.; Turhollow, A.F. Oak Ridge National Lab., TN (USA). [1990]. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From North American conference on forestry responses to climate change; Washington,

DC (USA); 15-17 May 1990. Order Number DE90016526. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Short-rotation woody crops (SRWC) have a significant potential for permanently mitigating carbon dioxide buildup in the atmosphere. The greatest benefit can be derived from growing large amounts of woody crops dedicated to substitute for fossil energy resources. Assuming current production and conversion technologies and a conservative estimate of the viable US land base (35 million acres), SRWC energy could displace 34 to 67 million tons of fossil carbon releases, 3 to 5% of current annual US emissions. Assuming predicted technology advancements and a high estimate of the US land base available for SRWC (103 million acres), SRWC energy could displace 272 to 470 million tons of annual fossil fuel carbon releases. The carbon mitigation potential of SRWC-based electricity production would be equivalent to about 7.5% of current global fossil fuel emissions and 35% of current total US fossil fuel emissions. This document discusses the strategies to mitigate carbon dioxide in the atmosphere. Topics include planting new trees, managing forests, improving forest utilization and using wood as a renewable energy source to replace fossil fuels. 16 refs., 2 figs., 4 tabs.

47502 (ECN-C–90-030) **CO- and NO_2-air pollution on parking lots: Case: Parking lot Leeuwenstraat, Rotterdam, Netherlands.** Boonekamp, P.G.M. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1990. 14p. (In Dutch). Order Number DE90519653. Source: NTIS (US Sales Only), PC A03/MF A01.

The Energy Study Center (ESC) of the Netherlands Energy Research Foundation executed some calculations with regard to the title subject. The results of the calculations supplement former calculations executed by the municipality of Rotterdam to determine the air pollution caused by carbon monoxide and nitrogen dioxide by means of the CAR model. The Rotterdam calculations, however, do not take into account the extra air pollution caused by starting cars. Considerably more pollutants are emitted by cars after a cold start the first few hundred meters in particular CO and hydrocarbons, than normal city traffic. The ESC calculations include these extra emissions. 1 fig., 4 refs., 3 tabs.

47503 (EGG–10282-1148) **An Aerial radiological survey of the Lawrence Livermore National Laboratory and surrounding area, Livermore, California: Date of survey, April 1986.** EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Remote Sensing Lab. Jul 1990. 30p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-83NV10282. Order Number DE90018001. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An aerial radiological survey was conducted over four areas in the California cities of Dublin, Livermore, and Tracy from 8 through 29 April 1986. Although a similar aerial survey had been previously conducted over Livermore and Tracy in 1975, this was the first such survey performed over the city of Dublin. The surveyed areas included the Camp Parks training facility in Dublin; the Las Positas Golf Course and the Livermore sewage treatment plant in west Livermore; the Lawrence Livermore National Laboratory (LLNL) facilities in east Livermore; and the LLNL facilities at Site 300 located three miles southwest of the city of Tracy, California. Only naturally-occurring radiation was detected over the Camp Parks area in Dublin and over the golf course and sewage treatment plant in west Livermore. Man-made radionuclides were detected over the LLNL facilities in east Livermore and over Site 300. These man-made sources were typical of source storage and radiological activities conducted at the facilities. In areas where only naturally-occurring gamma emitters were detected, the observed range of activity was essentially the same in both the 1975 and 1986 surveys. 14 figs., 3 tabs.

47504 (EML–530) **Semi-annual report of the Department of Energy, Operational Safety, Health and Environment Division, Quality Assessment Program.** Sanderson, C.G.; Scarpitta, S.C. USDOE Environmental Measurements Lab., New York, NY (USA). 2 Jul 1990. 101p. Sponsored by U.S. DOE Energy Research. Order Number DE90017277. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report presents the results from the analysis of the 32nd set of environmental quality assessment samples (QAP XXXII) that were received on or before June 5, 1990. This Quality Assessment Program (QAP) is designed to test the quality of the environmental measurements being reported to the Department of Energy by its contractors. Since 1976, real or synthetic environmental samples that have been prepared and thoroughly analyzed at the Environmental Measurements Laboratory (EML) have been distributed at first quarterly and then semi-annually to these contractors. Their results, which are returned to EML within 90 days, are compiled with EML's results and are reported back to the participating contractors 30 days later. A summary of the reported results is available to the participants 3 days after the reporting deadline via a modem-telephone connection to the EML computer. This is the 39th report of this program.

47505 (LA-UR–90-2735) **Continuous air monitor for alpha-emitting aerosol particles.** McFarland, A.R. (Texas A and M Univ., College Station, TX (USA). Dept. of Mechanical Engineering); Ortiz, C.A.; Rodgers, J.C.; Nelson, D.C. Los Alamos National Lab., NM (USA). [1990]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900809–3: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Order Number DE90016511. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new alpha Continuous Air Monitor (CAM) sampler is being developed for use in detecting the presence of alpha-emitting aerosol particles. The effort involves design, fabrication and evaluation of systems for the collection of aerosol and for the processing of data to speciate and quantify the alpha emitters of interest. At the present time we have a prototype of the aerosol sampling system and we have performed wind tunnel tests to characterize the performance of the device for different particle sizes, wind speeds, flow rates and internal design parameters. The results presented herein deal with the aerosol sampling aspects of the new CAM sampler. Work on the data processing, display and alarm functions is being done in parallel with the particle sampling work and will be reported separately at a later date. 17 refs., 5 figs., 3 tabs.

47506 (LBL–26455, pp. 115) **Nitrogen oxides from high-altitude aircraft: An update of potential effects on ozone.** Johnston, H.S.; Kinnison, D.C.; Wuebbles, D.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A sensitivity study was carried out using the LLNL one-dimensional (1D) and two-dimensional (2D) chemical-radiative-transport models of the global atmosphere to examine possible effects of future aircraft NO_x emissions on stratospheric ozone. A broad range in magnitude, altitude, and latitude of the assumed NO_x emissions was examined. Major findings of this initial study were: (1) Nitrogen oxides from the exhaust gases of stratospheric aircraft can reduce stratospheric ozone on a global basis. (2) The altitude at which NO_x emissions cause the largest reduction in the ozone column is about 25 km, according to 1D model calculations. (3) For a given altitude and magnitude of NO_x emissions, the 2D model finds that the reduction of global ozone depends only weakly on latitude of the injections. (4) For very large Cl_y mixing ratios, NO_x emissions can increase the ozone column, partially counteracting the ozone reduction caused by Cl_x. (5) The effect of water vapor emission at a factor of 90 greater than the NO_x emissions has negligible effect on ozone, compared to the effects of the assumed NO_x emissions. (6) Calculated global reductions of ozone due to NO_x emissions are smaller in the 2D model than in the 1D model.

47507 (ORNL/FTR–3714) **[Research on climate change]: Foreign trip report, August 2, 1990–August 14, 1990.** Nelson, T.R. Oak Ridge National Lab., TN (USA). 23 Aug 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016726. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of the August 8–13 visit to Beijing, People's Republic of China (PRC), was to assist with research under the joint US Department of Energy (DOE)/PRC Academia Sinica agreement "ANNEX III to the Protocol on Fossil Energy Research and Development on Cooperation in the Field of Atmospheric Trace Gases, Article III — Means of Cooperation," signed August 19, 1987, on

carbon dioxide and climate research. Assistance was given in the form of technical expertise in the design and implementation of data acquisition, certification, and analysis systems. These systems consisted of personal computers running database management software, FORTRAN, and graphics software. This report gives relevant background information and summarizes the traveler's activities as they relate to the installation of the computer systems in Beijing.

47508 (ORNL/TM–11538) **Rapid environmental organic analysis by direct sampling Glow Discharge Mass Spectrometry and Ion Trap Mass Spectrometry: Summary of pilot studies: Final report.** Wise, M.B.; Buchanan, M.V.; Guerin, M.R. Oak Ridge National Lab., TN (USA). Mar 1990. 53p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. (CETHA-TE-CR–90029). Order Number DE90016687. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Direct Sampling Mass Spectrometry (DSMS) techniques employing both Glow Discharge Mass Spectrometry and Ion Trap Mass Spectrometry are being developed to quantitatively determine preselected organics in water, soil, and air samples at part per billion levels in less than five minutes. Direct sampling requires little or no sample preparation and no prior chromatographic separation and is applicable to both volatile and semivolatile organics. 25 figs., 3 tabs.

47509 (PB–90-234717/XAB) **Background document for Third Third wastes to support 40 CFR part 268 land-disposal restrictions. Final rule. Third Third waste volumes, characteristics, and required and available treatment capacity. Volume 4. Appendix J-Appendix M.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. May 1990. 176p. (EPA–530/SW-90/062D). Source: NTIS, PC A09/MF A01.

See also Volume 3, PB–90-234709. Also available in set of 4 reports PC E99/MF E99, PB–90-234675.

The appendix discusses EPA's sludge/solid combustion capacity verification analysis.

47510 (PB–90-239971/XAB) **Audit materials for semivolatile organic measurements during hazardous-waste trial burns. Summary report.** Albritton, J.R.; Wright, R.S.; Eaton, W.C.; Jayanty, R.K.M. Research Triangle Inst., Durham, NC (USA). Apr 1990. 40p. Contracts EPA-68-02-3992, EPA-68-02-4125. Source: NTIS, PC A03/MF A01.

Measurement and monitoring research efforts are designed to anticipate environmental problems, to support regulatory actions by developing an indepth understanding of the nature and processes that impact health and the ecology, to provide innovative means of monitoring compliance with regulations, and to evaluate the effectiveness of health and environmental protection efforts through the monitoring of long-term trends. Method 0010 of SW 846 is the required test method used to show Destruction and Removal Efficiency (DRE) of Principle Organic Hazardous Constituents (POHCs) of semi-volatile (boiling point above 130 C) organic compounds. This method requires extraction and evaporation concentrating of the semi-volatile organics. The procedure, if not done properly, can result in significant loss of POHCs and, therefore, it is important to have an audit material to test the performance of laboratories making these important measurements. Two approaches for the audit material are described in the report: one which tests both the sample train recovery and analytical recovery and one which tests the analytical performance only.

47511 (PB–90-240581/XAB) **Chamber and modeling study to assess the photochemistry of formaldehyde. Final report, February 1988-February 1990.** Jeffries, H.E.; Sexton, K.G.; Arnold, J.R.; Bai, Y.; Li, J.L. North Carolina Univ., Chapel Hill, NC (USA). School of Public Health. Jul 1990. 313p. Source: NTIS, PC A14/MF A02.

A new analytical method for formaldehyde (HCHO) was implemented for use in the UNC outdoor smog chamber. HCHO measurements obtained with this method were compared with those obtained using other analytical techniques. Six different calibration standards for HCHO were found to agree within + or -2%, and the different HCHO analytical methods had precisions of + or - 10%. New experiments in which HCHO was produced chemically were performed. An explicit chemical reaction mechanism for ethene and propene was formulated to explain the chamber observations. The ethene mechanism showed excellent agreement with the observed data; the propene mechanism, however, did not perform as satisfactory. A comparison of these explicit mechanisms with the Carbon Bond IV (CB4) mechanism showed excellent agreement for ozone (<10% error), nitrogen oxides, and hydrocarbon oxidation rates; the CB4, however, consistently underpredicted the HCHO maximum by about 13%. An analysis of a simulation of an urban scenario showed that chemical production of HCHO was the dominant factor governing afternoon HCHO concentrations. Ethene and other olefins were the source of 58-62% of the HCHO produced and aromatics were responsible for 10-12%. It was concluded that the CB4 mechanism can be used to predict ambient HCHO levels with an error of about 20%.

47512 (PB–90-242314/XAB) **Emission factors for iron and steel sources: Criteria and toxic pollutants. Final report.** Barnard, W.R. Pechan (E.H.) and Associates, Inc., Durham, NC (USA). Jun 1990. 173p. Contract EPA-68-02-4271. Source: NTIS, PC A08/MF A01.

The report provides a comprehensive set of emission factors for sources of both criteria and toxic air pollutants in integrated iron and steel plants and specialty electric arc shops (mini-mills). Emission factors are identified for process sources, and process and open source fugitive emissions. The emission factors are not specific to any one facility. Emission factors for gray iron foundries and the ferro-alloy industry are not included.

47513 (PB–90-245242/XAB) **Foliar leaching and root uptake of Ca, Mg and K in relation to acid fog effects on Douglas Fir.** Turner, D.P.; Tingey, D.T. Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. ©1990. 12p. (EPA–600/J-90/069). Source: NTIS, PC A03/MF A01.

Pub. in Water, Air and Soil Pollution, Vol. 49, 205-214(1990).

The impact of acid fog on foliar leaching and root uptake of Ca, Mg, and K by Douglas-fir (Pseudotsuga menziesii) seedlings was examined. In a factorial experiment, 1-year old seedlings were grown in a solution culture at two levels of nutrient availability (low and moderate) and exposed twice a week (4 hr per event) for 12 weeks to fog at pH 5.6 or pH 3.1. Throughfall enrichment of Ca, Mg and K was determined from drip collectors at the base of each seedling and root uptake rates for trees under the moderate nutrient regime were evaluated by monitoring nutrient solution depletion. Throughfall enrichment was higher in the pH 3.1 fog than the pH 5.6 fog but much of the enrichment appeared to be wash off of precipitate from previous fogs. The amounts of nutrients coming off of the foliage with the low pH fog were small relative to the daily uptake rates. Foliar concentrations of K and Mg at the end of the exposures were lower under the low nutrient regime but were not affected by fog pH. Comparisons of wax weight and examinations of epicuticular wax by electron microscopy did not indicate a significant impact from exposure to the low pH fog.

47514 (PB–90-245259/XAB) **Improved method for measuring aerosol strong acidity: Results from a nine-month study in St. Louis, Missouri and Kingston, Tennessee.** Koutrakis, P.; Wolfson, J.M.; Spengler, J.D. Harvard Univ., Boston, MA (USA). School of Public Health. ©1988. 8p. Contract EPA-R-811650. Source: NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 1, 157-162(Feb 1988).

An improved method for measuring strong acidity of atmospheric aerosols is presented. An ammonia diffusion denuder was developed to prevent neutralization of the acidic aerosol samples. In addition, a new procedure for protecting samples during shipment and analysis was used. An increase in the sensitivity of the analysis was achieved by extraction of the aerosol sample in a small solution volume, 3 ml, of .0001 N $HClO_4$, and the use of a microelectrode for pH determination. Finally, results from a nine-month study in St. Louis, Missouri and Kingston, Tennessee are given.

47515 (PB–90-245341/XAB) **Evaluating sources of indoor air pollution. Report for March 1988-May 1989.** Tichenor, B.A.; Sparks, L.E.; White, J.B.; Jackson, M.D. Environmental Protection

Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. ©Apr 1990. 8p. (EPA–600/J-90/055). Source: NTIS, PC A02/MF A01.

Pub. in Jnl. of Air Waste Management Association, Vol. 40, No. 4, 487-492(Apr 1990). See also PB–88-211685.

The article discusses a three-phase approach, employing environmental chambers, indoor air quality (IAQ) models, and test house experiments, that is effective in linking sources of indoor pollutants to measured concentrations. Emission factors developed in test chambers can be used to evaluate full-scale indoor environments. A PC-based IAQ model has been developed that can accurately predict indoor concentrations of specific pollutants under controlled conditions in a test house. The model is also useful in examining the effect of pollutant sinks and variations in ventilation parameters. Pollutants were examined from: para-dichlorobenzene emissions from moth crystal cakes, and particulate emissions from unvented kerosene heaters. However, the approach has not been validated for other source types.

47516 (PB–90-245671/XAB) **Evaluation of methods for simultaneous collection and determination of nicotine and polynuclear aromatic hydrocarbons in indoor air.** Chuang, J.C.; Kuhlman, M.R.; Wilson, N.K. Battelle Columbus Div., Washington, DC (USA). ©1990. 7p. (EPA–600/J-90/068). Source: NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 24, No. 5, 661-665(1990).

A study was performed to determine whether one sampling system and one analytical method can be used to measure both polynuclear aromatic hydrocarbons (PAH) and nicotine. The PAH collection efficiencies for both XAD-2 and XAD-4 adsorbents are very similar, but the nicotine collection efficiency was greater for XAD-4. The spiked perdeuterated PAH were retained well in both adsorbents after exposure to more than 300 cu m of air. A two-step Soxhlet extraction, dichloromethane followed by ethylacetate, was used to remove nicotine and PAH from XAD-4. The extract was analyzed by positive chemical ionization or electron impact gas chromatography/mass spectrometry (GC/MS) to determine nicotine and PAH. It is shown that one sampling system (quartz fiber filter and XAD-4 in series) and one analytical method (Soxhlet extraction and GC/MS) can be used to measure both nicotine and PAH in indoor air.

47517 (PB–90-245689/XAB) **Development and evaluation of an acid-precipitation monitor for fractional event sampling with capability for real-time pH and conductivity measurement.** Kronmiller, K.G.; Ellenson, W.D.; Baumgardner, R.E.; Stevens, R.K.; Paur, R.J. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. ©1990. 14p. (EPA–600/J-90/067). Source: NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 24, No. 3, 525-536(1990).

An acid precipitation monitor has been developed that collects fractions of rain events, measures the pH and conductivity in real-time, and stores the remaining samples under refrigerated conditions. A Z-80 microprocessor controls all operations of the monitor including sample collection, sample analysis, quality control analysis, and data recording. Quality control analysis consists of analysis upon demand of a low-ionic-strength solution. The monitor was evaluated in the field and about 40 rain events were monitored. Excellent stability of the pH electrode was found under field conditions.

47518 (PB–90-245697/XAB) **Identification of volatile hydrocarbons as mobile source tracers for fine-particulate organics.** Zweidinger, R.B.; Stevens, R.K.; Lewis, C.W.; Westburg, H. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. ©1990. 7p. (EPA–600/J-90/066). Source: NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 24, 538-542(1990).

Several volatile organic compounds (VOCs) have been identified as candidates for tracers of fine particulate carbon and Extractable Organic Matter (EOM) from mobile sources. The identification resulted from a multiple screening procedure in which the ambient concentrations of a candidate VOC were first required to have both a high correlation with ambient concentrations of fine particulate Pb, a well established tracer of mobile source emissions, and a low correlation with soil-corrected fine particle potassium (K'), a previously demonstrated tracer of woodsmoke, using measurements from an airshed in which these were the dominant sources. Each VOC surviving this screening was then substituted in place of Pb, and along with K', in multi-linear regression representations of the carbon and EOM data. Successful VOCs resulted in a multiple correlation coefficient (r^2) at least as good as with K' and Pb, and estimates of the woodsmoke and mobile source contributions virtually the same as with K' and Pb. The reasonableness of these VOCs as mobile source tracers was affirmed by considering what is known about the abundance of those VOCs in woodsmoke and mobile source emissions.

47519 (PB–90-245713/XAB) **Formaldehyde production in photochemical smog as predicted by three state-of-the-science chemical oxidant mechanisms.** Dodge, M.C. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. ©1990. 16p. (EPA–600/J-90/065). Source: NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 95, No. D4, 3635-3648(20 Mar 1990).

A moving box model was used to compare formaldehyde (HCHO) predictions obtained with three photochemical oxidant mechanisms. In simulations using a typical urban mix of organic pollutants, the mechanisms were found to yield HCHO predictions that agreed to within 10% of each other provided the same reaction rates were used in all three mechanisms to describe the photolysis of HCHO. The agreement for simulations using pollutant mixtures containing only one organic species showed more variability. Formaldehyde predictions obtained under typical urban conditions for ethene, propene, and acetaldehyde were in excellent agreement; significant differences, however, were noted for the 2-alkenes and aromatic hydrocarbons. Predictions of ozone and hydrogen peroxide obtained with the urban mixture were very sensitive to the initial concentration of HCHO included in the simulations. Depending on whether HCHO was assumed to constitute 0% or 2% of the initial mix of organic pollutants, resulting ozone yields varied by as much as 15-30%; hydrogen peroxide yields differed by factors of 4-10 depending on the mechanism used. To estimate the effectiveness of various control measures for limiting HCHO production, simulations were also conducted where individual organic species within the urban mix were reduced and the resulting decreases in HCHO yields were noted. The largest decreases in HCHO predictions occurred for reductions in ethene and the other 1-alkenes; the smallest decreases were obtained when the monoalkylbenzenes or the alkanes were reduced.

47520 (PB–90-245853/XAB) **Global climate change and agriculture: An economic perspective.** Adams, R.M. Oregon State Univ., Corvallis, OR (USA). Dept. of Agricultural and Resource Economics. ©1989. 10p. Source: NTIS, PC A02/MF A01.

Pub. in American Jnl. of Agricultural Economics, Vol. 71, No. 5, 1272-1279.

Climate change and related global concerns dominate the current environmental agenda as evidenced by the recent wave of articles, symposia, workshops, and other scientific and lay forms dealing with the issue. While most atmospheric scientists agree that a climate change signal has yet to be detected, concern over potential climate change arising from increasing concentrations of carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and other greenhouse gases is motivating substantial funding increases for such research. Climate change is thus likely to be a major research and policy issue well into the next decade. Scientific interest in climate changes is not a recent phenomenon; research on the relationship between CO_2, climate and man dates back at least to 1895. Despite substantial uncertainties in the understanding of climate change cause and effects, a scientific consensus has emerged about some aspects of the phenomenon: CO_2 and other trace gases are increasing, and these increases will at some point alter the world's climate.

47521 (PB–90-246091/XAB) **Evaluation of an anion-exchange resin for sampling ambient-level phenolic**

compounds. Report for 1 December 1988-30 September 1989. Nishioka, M.; Burkholder, H. Battelle Columbus Div., Washington, DC (USA). 27 Apr 1990. 127p. Contract EPA-68-02-4127. Source: NTIS, PC A07/MF A01.

The determination of human exposure to polar volatile and semivolatile organic compounds is an area of increasing importance to EPA. Since the bioavailability of many polar compounds is greater than for relatively non-polar compounds, methods are needed for the selective sampling and analysis of these types of compounds. The anion exchange resin AG MP-1 was evaluated for selective collection and retention of vapor phase phenolic compounds. The primary goal of the program was development of sampling and analysis conditions which would permit detection and quantification of diverse phenolic and hydroxylated species at ambient levels of 1 ppbv. Phenols (and other acidic compounds) are retained on AG MP-1 by formation of a chemical bond; the reaction is reversed to liberate the phenols from the sorbent prior to analysis. Because of the dominant concern about collection and recovery, investigations here centered upon those parameters which affect the formation of the initial chemical bond between phenolic analyte and sorbent and those procedures that allow subsequent reversal of these reactions for quantitative recovery of analytes in the laboratory.

47522 (PB–90-246174/XAB) **Trace metal fate in a rotary-kiln incinerator with an ionizing wet scrubber.** Waterland, L.R.; Fournier, D.J.; Lee, J.W.; Carroll, G.J. Environmental Protection Agency, Cincinnati, OH (USA). Risk Reduction Engineering Lab. 1990. 12p. Contract EPA-68-C9-0038. Source: NTIS, PC A03/MF A01.

A series of pilot-scale incineration tests was performed at EPA's Incineration Research Facility (IRF) in Jefferson, Arkansas, to evaluate the fate of trace metals fed to a rotary kiln incinerator equipped with an ionizing wet scrubber (IWS) for particulate and acid gas control. Test variables were kiln temperature, ranging from 816 to 927 C (1500 to 1700 F); afterburner temperature, ranging from 982 to 1204 C (1800 to 2200 F); and feed chlorine content, ranging from 0 to 8 percent. The test program evaluated the fate of five hazardous constituent trace metals (arsenic, barium, cadmium, chromium, and lead) and four nonhazardous constituent trace metals (bismuth, copper, magnesium, and strontium). The test results indicate that cadmium and bismuth were relatively volatile, with an average of less than 40 percent discharged with the kiln ash. Arsenic, barium, chromium, copper, lead, magnesium, and strontium were relatively nonvolatile, with an average of greater than 80 percent discharged with the kiln ash. Observed relative metal volatilities generally agreed with the volatilities predicted based on vapor pressure/temperature relationships, with the exception of arsenic which was much less volatile than predicted. The volatility of cadmium, bismuth, and lead increased as kiln temperature was increased; the discharge distributions of the remaining metals were not significantly affected by changes in kiln temperature. Apparent scrubber collection efficiencies for the metals averaged 22 to 71 percent, and were generally higher for the less volatile metals. The overall average metal collection efficiency was 43 percent.

47523 (PB–90-246216/XAB) **EPA air monitoring bank proposal.** Lee, R.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. Sep 1989. 12p. (EPA–600/D-90/070). Source: NTIS, PC A03/MF A01.

Specimen banking of air pollution samples has not been attempted because of the complexity of this type of environmental medium. Pollutants may exist in air as gases or particles or distributed in between these two states. Empirically, air pollutants may be categorized as volatiles, semivolatiles, or nonvolatiles based on vapor pressure. Since no single collection device exists for all three categories, very different monitoring technologies are required for each. The most promising approach for air specimen banking is to focus on the semivolatile fraction using a sampler that consists of a filter followed by a downstream sorbent material to collect gases. The combined solvent extract of both the filter and the sorbent can thereby be cryogenically preserved for retrospective analysis.

47524 (PB–90-246232/XAB) **Development of a simple indicator for measuring the performance of incinerators, industrial furnaces, and boilers burning hazardous waste. Report for October 1989-March 1990.** Lemieux, P.M.; Linak, W.P.; McSorley, J.A.; Wendt, J.O.L.; Dunn, J.E. Arizona Univ., Tucson, AZ (USA). Dept. of Chemical Engineering. 1990. 14p. Contract EPA-68-02-4701, Grant EPA-R-814945-02. Source: NTIS, PC A03/MF A01.

The paper discusses the development of a simple indicator–Unsatisfied Oxygen Demand (UOD)–for measuring the performance of incinerators, industrial furnaces, and boilers burning hazardous waste. Current RCRA regulations use destruction and removal efficiency (DRE) of the principal organic hazardous constituents (POHCs) in the feed as the main regulatory parameter to determine performance of facilities incinerating hazardous waste during a RCRA trial burn. Calculating DRE, however, is expensive and time consuming on a regular basis, and it is impossible to measure DRE continuously using existing on-line analyzers. In addition, DRE does not address potential emissions of toxic compounds that can be formed as products of incomplete combustion (PICs) during incineration. Experiments on a 73 kW rotary kiln incinerator simulator equipped with a 58.4 kW afterburner/control temperature tower have been performed to aid in the development of a uniform, easy-to-measure performance indicator for comparing transient puffs generated by batch incineration of different types of surrogate wastes. By utilizing time-integrated responses from process gas analyzers, rather than instantaneous or averaged responses, it is possible to derive an indicator of the relative degree of local oxygen starvation that waste material was exposed to while passing through the incinerator.

47525 (PB–90-246240/XAB) **Stratification of particulate and VOC pollutants in paint spray booths, June 1990. Report for April 1988-April 1989.** Darvin, C.H.; Ayer, J. Acurex Corp., Mountain View, CA (USA). 1990. 14p. Contract EPA-68-02-4285. Source: NTIS, PC A03/MF A01.

See also PB–90-220831.

The paper discusses flow management as part of a joint EPA/U.S. Air Force program on emissions from paint spray booths. The goal of the program is to identify and develop efficient and economical emissions control concepts for this source. Flow management is one potential solution that reduces the volume of gases that must be processed in a control system. Although it will not itself control pollution, it can influence the economic and technical viability of subsequent control systems. The test program discussed here was designed to characterize the pollutants both within and exiting a typical back-draw booth for which emissions control and flow management strategies are being developed. Study results indicate that both particulate and volatile organic compounds (VOCs) fall to the lower level of the booth or, at most, stratify at the level at which they were generated. Results indicate that the concentration at the lower level of the booth near the exhaust was from 5 to 25 times greater than that at the upper level. The importance of these findings is that it might be possible to partition a booth's air flow into two zones, one lean and the other concentrated. The enriched lower zone could then be directed to a proportionately smaller VOC control system, of lower capital and operating costs.

47526 (PB–90-246257/XAB) **Emissions from cofiring surrogate hazardous waste in a commercial packaged boiler. Report for August 1986-May 1987.** Wasser, J.H.; Srivastava, R. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1990. 15p. (EPA–600/D-90/053). Source: NTIS, PC A03/MF A01.

The paper gives results of a study of steady state and transient operating conditions when cofiring surrogate liquid hazardous waste in a firetube packaged boiler. The destruction and removal efficiencies (DREs) for the principal organic hazardous constituents (POHCs) were determined under the varying conditions. Results indicate that aromatic chlorocarbons are the most difficult to destroy. A DRE of <99.99% was experienced for transient operating conditions in load, stoichiometry, and waste feed rate. Steady operation above 10% excess air ensures DREs of >99.99%. Major products of incomplete combustion (PICs) seen were methylene chloride and chloroform.

47527 (PB–90-246265/XAB) **Success of EPA's stratospheric-ozone engineering research.** Rhodes, W.J.; Shapiro, P.S. Environmental Protection Agency, Research Triangle

Park, NC (USA). Air and Energy Engineering Research Lab. 1990. 12p. (EPA–600/D-90/084). Source: NTIS, PC A03/MF A01.

The paper summarizes recent successes in, as well as work in progress (with the cooperation of industry) on, EPA's stratospheric ozone engineering research. The Montreal Protocol and U.S. regulations implementing the Protocol necessitate that engineering solutions be found and implemented to avoid the use of certain chlorofluorocarbons (CFCs) and halons. CFCs and halons are used for solvents, refrigerants, aerosol propellants, foams, and fire protection. Nearly all EPA activities in this program involve pollution prevention as the first alternative. This includes alternative processes, alternative chemicals, alternative means of accomplishing the desired service, and recycling. Industry cooperation is needed in order to take advantage of industry's expertise, to get industry to buy into the solution, to conserve valuable time and resources, and to implement results rapidly. Since the problem will be solved only through international efforts, the U.S. is also placing high priority on technical assistance to developing countries.

47528 (PB–90-246323/XAB) **Reduction of CFC usage in US exempted and excluded aerosols.** Smith, N.D. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1990. 15p. (EPA–600/D-90/049). Source: NTIS, PC A03/MF A01.

The paper examines products exempted and excluded from the 1978 U.S. ban on the use of chlorofluorocarbons (CFCs) as aerosol propellants. Consumption of CFCs still utilized for these products in the U.S. amounts to about 25.5 million lb (11.6 million kg) per year. Alternative formulations which may be used to reduce or eliminate the CFC content of these products are discussed. It is technically feasible to replace about 40% of the CFC usage in these products with alternative propellants available today. However, seven categories of products are identified for which immediate replacement of all of the CFC content is not technically feasible. Complete CFC replacement in these products must await the commercialization of newer substitute chemicals currently being developed by industry. Nevertheless, some reformulation is possible in the interim for some of the seven categories, allowing reduced CFC usage.

47529 (PB–90-246331/XAB) **Verification and uses of the Environmental Protection Agency (EPA) indoor air quality model.** Sparks, L.E.; Tichenor, B.A.; Jackson, M.D.; White, J.B. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1989. 20p. (EPA–600/D-90/052). Source: NTIS, PC A03/MF A01.

The paper describes a set of experiments used to verify an indoor air quality (IAQ) model for estimating the impact of various pollution sources on IAQ in a multiroom building. The model treats each room as a well-mixed chamber that contains pollution sources and sinks. The model allows analysis of the impact of room-to-room air flows, HVAC (heating, ventilating, and air-conditioning) systems, and air cleaners on IAQ. The model is written for personal computers. The experiments were conducted in a test house. Three pollution sources were used: moth crystals, kerosene heaters, and dry cleaned cloths. The model predictions were in good agreement with the experimental data, especially when a sink term was included in the model. The paper gives a brief discussion of the theory on which the model is based. Preliminary data and theory of sources and sinks are also discussed. Examples demonstrating the use of the model to analyze IAQ options and to estimate exposure from a pollutant are included.

47530 (PB–90-246356/XAB) **Recycle and disposal options for CFC's and halons.** Harmon, D.L.; Rhodes, W.J. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1990. 16p. (EPA–600/D-90/050). Source: NTIS, PC A03/MF A01.

The paper discusses recycle and disposal options for chlorofluorocarbons (CFCs) and halons. These options will become more important as supplies become limited in compliance with the Montreal-Protocol, particularly if these chemicals are completely phased out by the year 2000, as called for by about 80 nations at the May 1989 Helsinki meeting. Even with new replacement chemicals, recycling will be important because of the higher cost and global warming that would result from release of the replacements. Options for the recovery, recycle, reclamation, and disposal of CFCs and halons need to be understood so that the most environmentally, technically, and economically effective systems can be selected. The options for recovery, recycle, reclamation, and disposal of CFCs and halons are reviewed briefly in the paper. A partial list of manufacturers of recovery/recycle equipment and those doing on- and off-site recovery/recycle/reclamation or planning to start this service in the near future is included.

47531 (PB–90-246414/XAB) **Regional and local vegetation patterns: The responses of vegetation to subcontinental air masses.** Neilson, R.P.; King, G.A.; DeVelice, R.L.; Lenihan, J.M. NSI Technology Services Corp., Corvallis, OR (USA). Mar 1990. 31p. Contract EPA-68-C8-0006. Source: NTIS, PC A03/MF A01.

Spatial patterns of biodiversity in plants were examined through a range of scales from continental and biome to patterns of local habitat variation. The authors propose a hierarchy of constraints on these patterns. Large-scale climate is proposed to structure continental patterns of species richness and the diversity and distribution of physiognomic types in the form of biomes. Within biomes regional climatic gradients modulate the length scales of habitats and, hence, the amount of substrate variation within a grain that is perceived by an organism as homogeneous. Most resource variation in the core of biomes is within a given species range of tolerance and large areas of the landscape are perceived as essentially homogeneous. As one moves toward ecotones, the convergence of regional climatic stresses constrains the suitability of habitats to smaller scale variations in substrate and topography. Thus, the size of habitat grain declines, while the diversity of habitat grains increases toward biome ecotones. Biotic interactions form a third level of constraint, operating at yet a smaller spatial scale, to further modify local species associations. The regional gradients in habitat size and variability provide explanatory power of observed patterns in biodiversity and provide a monitoring tool for climate-induced changes in ecotones.

47532 (PB–90-247198/XAB) **Application guide for measurement of PM2.5 at stationary sources.** Dawes, S.S.; Farthing, W.E. Southern Research Inst., Birmingham, AL (USA). Jul 1990. 106p. Contract EPA-68-02-4442. Source: NTIS, PC A06/MF A01.

The manual presents two options which allow determination of stationary source PM2.5 to be measured in conjunction with PM10 and it can be measured as PM2.5 only. When determining both PM2.5 and PM10, either the Constant Sampling Rate (CSR) procedures or the Exhaust Gas Recycle (EGR) sampling system can be used. When PM2.5 is the only size fraction of interest the CSR procedures are selected. The application guide should be used as a companion to the application guides for CSR and EGR. Stack gas is sampled at multiple points using an in-stack inertial sampler with a constant flow rate. For PM2.5 measurements only, the maximum allowable error due to anisokinetic sampling is + or -10% for 2.5 micrometer particles. The range of duct velocities permitted for a nozzle with this maximum allowable error is broad enough that rarely is it necessary to break a traverse into subtraverses with different sampling nozzles. The sampling device described in the manual is Cyclone IV of the SRI/EPA five-stack series cyclone. This device provides a 2.5 micrometer size cut at a flow rate of approximately 0.36 dscfm; the precise flow rate depends on local stack conditions. These procedures specify the precise flow rate for PM2.5 separately and PM10 when the described cyclone particle sizers are used.

47533 (PB–90-247453/XAB) **Evaluation of strategies for promoting effective radon mitigation. Risk communication and economic research series. Final report.** Doyle, J.K.; McClelland, G.H.; Schulze, W.D.; Locke, P.A.; Elliott, S.R. Colorado Univ., Boulder, CO (USA). Mar 1990. 193p. Source: NTIS, PC A09/MF A02.

The Environmental Protection Agency has estimated that as many as 20,000 lung cancer deaths per year in the United States can be attributed to exposure to radon gas. The report evaluates alternative strategies for motivating people to test for radon gas in their homes and to mitigate if necessary. Specifically, two separate radon information and awareness programs were evaluated, one targeted to the general population in the Washington, D.C. area and the other to home buyers in the Boulder, Colorado area. The results suggest that a home buyer program is likely to be far more effective in terms of effective remediation to reduce home radon

levels than a program aimed at the general population. The report discusses the empirical findings and develops a recommendation for increasing the effectiveness of radon awareness and mitigation programs.

47534 (PB–90-247487/XAB) **Distillation operations in synthetic organic chemical manufacturing industry. Background information for promulgated standards. Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jun 1990. 136p. (EPA–450/3-83/005B). Source: NTIS, PC A07/MF A01.

See also PB–84-214006.

Standards of performance for the control of volatile organic compound (VOC) emissions from distillation unit operations in the synthetic organic chemical manufacturing industry are being promulgated under Section 111 of the Clean Air Act. These standards will apply to VOC emissions from newly constructed, modified, and reconstructed distillation units. The document summarizes the responses to public comments received on the proposed standards and the basis for changes made since proposal.

47535 (PB–90-247495/XAB) **Air oxidation processes in synthetic organic chemical manufacturing industry: Background information for promulgated standards. Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jun 1990. 80p. (EPA–450/3-82/001B). Source: NTIS, PC A05/MF A01.

See also PB–84-114834.

Standards of performance for the control of volatile organic compound (VOC) emissions from air oxidation processes in the synthetic organic chemical manufacturing industry are being promulgated under Section 111 of the Clean Air Act. These standards will apply to VOC emissions from newly constructed, modified, and reconstructed air oxidation processes. The document summarizes the responses to public comments received on the proposed standards and the basis for changes made since proposal.

47536 (PB–90-249442/XAB) **Progress toward implementing Superfund. Fiscal year 1988. Report to the Congress.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. Apr 1990. 479p. (EPA–540/8-90/004). Source: NTIS, PC A21/MF A03.

See also PB–89-233548.

The EPA's Annual Report includes the progress made by the Agency during Fiscal Year 1988 in implementing CERCLA (or Superfund), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The report provides an overall perspective on progress in 1988, and, in addition, also contains information that Congress specifically requested, including a detailed description of each of the 152 Records of Decision (RODs) that were signed in fiscal year 1988; a report on the status of remedial actions, including enforcement activity, in progress at the end of the fiscal year; and an evaluation of newly developed feasible and achievable permanent treatment technologies.

47537 (PB–90-252503/XAB) **Hazardous-waste treatment, storage, and disposal facilities. Background information for promulgated organic emission standards for process vents and equipment leaks.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jun 1990. 396p. (EPA–450/3-89/009). Source: NTIS, PC A17/MF A03.

See also PB–90-103250.

Standards for the control of organic air emissions from hazardous waste treatment, storage, and disposal facilities (TSDF) and waste solvent treatment facilities (WSTF) are promulgated under the authority of Section 3004(n) of the 1976 Resource Conservation and Recovery Act (RCRA). These standards would apply to certain process vents associated with distillation and stripping equipment at WSTF (and at TSDF, if applicable) and to fugitive emissions from equipment leaks at TSDF where the waste stream (or its derivatives) contain 10 percent or more total organics. The document contains summaries of public comments received on the proposed rule (February 5, 1987), EPA responses, and a discussion of differences between the proposed and final standards.

47538 (PNL–7200-Pt.3) **Pacific Northwest Laboratory annual report for 1989 to the DOE [Department of Energy] Office of Energy Research: Part 3, Atmospheric sciences.** Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 75p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. Order Number DE90016660. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This 1989 Annual Report from Pacific Northwest Laboratory (PNL) to the US Department of Energy (DOE) describes research in environment, safety, and health conducted during fiscal year 1989. The report again consists of five parts, each in a separate volume. This volume contains research in the atmospheric sciences. Currently, the broad goals of atmospheric research at PNL are to describe and predict the nature and fate of atmospheric contaminants and to develop an understanding of the atmospheric processes contributing to their distribution on local, regional, continental, and global scales in the air, in clouds, and on the surface. The redistribution and long-range transport of transformed contaminants passing through clouds is recognized as a necessary extension of our research to even larger scales in the future. Eventually, large-scale experiments on cloud processing and redistribution of contaminants will be integrated into the national program on global change, investigating how energy pollutants affect aerosols and clouds and the transfer of radiant energy through them. As the significance of this effect becomes clear, its global impact on climate will be studied through experimental and modeling research. The description of ongoing atmospheric research at PNL is organized in terms of the following study areas: atmospheric studies in complex terrain, large-scale atmospheric transport and processing of emissions, and climate change. This report describes the progress in FY 1989 in each of these areas. A divider page summarizes the goals of each area and lists project titles that support research activities. 9 refs., 2 figs., 3 tabs.

47539 (PNL-SA–17429) **A fiber-optic spectrochemical emission sensor as a detector for volatile chlorinated compounds.** Olsen, K.B. (Pacific Northwest Lab., Richland, WA (USA)); Griffin, J.W.; Matson, B.S.; Kiefer, T.C.; Flynn, C.J. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900402–9: 199. national meeting of the American Ceramic Society, Boston, MA (USA), 22-27 Apr 1990). Order Number DE90016296. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A radio frequency induced helium plasma (RFIHP) detector was designed and tested as a sensor for volatile chlorinated compounds. The RFIHP detector uses a critical orifice air inlet and an RF-excited sub-atmospheric pressure helium plasma to excite the ambient air sample. The excitation source is coupled to a fiber-optic cable and associated collection optics to monitor the emission intensity of the 837.6-nm emission line of chlorine. The RFIHP detector demonstrated linearity from 0 to 500 ppMv carbon tetrachloride with a correlation coefficient of 0.996 and excellent reproducibility. The detection limit for carbon tetrachloride in air was 5 ppMv. Fluorinated compounds can also be readily analyzed by changing the analytical wavelength to 739.9 nm. 10 refs., 9 figs.

47540 (PNL-SA–17536) **Energetics of valley and basin atmospheres during the evening transition and nighttime periods.** Whiteman, C.D. Pacific Northwest Lab., Richland, WA (USA). Mar 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-9006111–6: Conference on mesoscale processes and mountain meteorology, Boulder, CO (USA), 25-29 Jun 1990). Order Number DE90016356. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In recent years there have been several attempts to calculate individual components of the heat budgets of various valleys and basins. The impetus for this work has generally been the desire to gain a better understanding of the role of the valley's heat budget in generating local thermally driven circulations. Methods for the calculation of such heat budgets are in an early state of development, and investigators have had difficulty in getting the heat budgets to close. The purpose of this paper is to present a conceptual framework for such calculations, to compare individual terms in several valleys and basins where bulk budget terms have been estimated, and to draw conclusions regarding the meteorology of valley and

basin atmospheres during the evening transition and nighttime periods. We begin by developing a mathematical framework that allows the calculation of individual heat budget terms in individual valleys and allows intercomparions between various valleys and basins. We then evaluate the change of heat storage term in a single valley to illustrate the effects of valley topography on the interpretation of this term. Finally, we evaluate the heat budgets for three different valleys and basins and consider the possible reasons for the poor closure of the budgets. 11 refs., 1 figs., 1 tab.

47541 (PNL-SA-17987) **Terrain-induced mesoscale circulations in the Columbia Basin.** Skyllingstad, E.D.; Doran, J.C. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-9006111-4: Conference on mesoscale processes and mountain meteorology, Boulder, CO (USA), 25-29 Jun 1990). Order Number DE90016338. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Mountain basins present a difficult problem for the analysis and prediction of local temperature and wind structure. The flow complexity is compounded by the formation of mountain gravity waves and subsequent downslope winds and increased mixing. The influence of the basin topography often leads to widely varying stability and surface winds. Basin meteorology is also strongly tied to the strength of solar heating and vertical structure of the local air column. Stagnation and strong inversions, resulting from weak flow aloft and low solar heating, are common in mountain basins and have a large impact on the transport and diffusion of atmospheric contaminants. As in many atmospheric flow problems, studying the structure of basin flow is hampered by the high cost of extensive field programs. Another option is the use of numerical models to supplement a limited observation program. Models can provide a reasonable diagnostic tool at low cost for gaining insight on the dynamics of geophysical fluid problems. Here, we examine the characteristics of a particular flow pattern that is common in the Columbia Basin located in south-central Washington State. This preliminary case study is performed using a combination of surface observations and vertical soundings and a data set generated by a hydrostatic numerical model. Our intent is to demonstrate the importance of terrain blocking and channeling on the circulation and trapping of cool air within a partially closed mountain basin.

47542 (PNL-SA-17988) **The effects of critical layers on atmospheric cnoidal waves.** Skyllingstad, E.D. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 3p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9006111-7: Conference on mesoscale processes and mountain meteorology, Boulder, CO (USA), 25-29 Jun 1990). Order Number DE90016540. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The topic of atmospheric cnoidal and solitary waves has received considerable attention in recent years. These waves are of interest because of their strength, permanence of form, and ability to travel long distances with minimal decrease in amplitude. Observations of solitary waves have identified two classes of disturbances. The first wave type, known as a wave of depression, extends through the depth of the atmosphere and is noticeable as a trough of low pressure at the surface. These waves are commonly observed downstream from regions of strong cyclogenesis suggesting a generation mechanism of convection, frontogenesis, or other mesoscale instability (Lin and Golf 1988). The second wave type, known as a wave of elevation, propagates along a surface inversion and is identified by a high-pressure spike. Waves of elevation are formed by the intrusion of a gust front or sea breeze beneath an existing inversion. This interaction leads to the formation of a bore or jump in the inversion height, that eventually develops undulations or cnoidal waves under the proper atmospheric conditions. Cnoidal wave systems have been observed by Christie et al. (1978), Clarke et al. (1981) and as single solitary waves such as presented by Doviak and Ge (1984). In previous investigations of cnoidal waves, conditions leading to complete or partial cnoidal wave trapping have been examined (Crook 1986; Crook 1988). Missing from these studies are cases where a critical level exists or the wave phase speed equals the ambient wind speed. Here, a numerical model is used to study critical levels as possible trapping mechanisms for cnoidal waves. 11 refs., 4 figs.

47543 (UCRL-JC-104734) **Global tropospheric chemistry modeling.** Penner, J.E. Lawrence Livermore National Lab., CA (USA). Aug 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-9009240-1: National academy of sciences committee on atmospheric change, Washington, DC (USA), 25-26 Sep 1990). Order Number DE90015908. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

To build a National Energy Strategy that is respectful of the environment, the effects of fossil fuel emissions on atmospheric chemistry and climate must be understood. Because many of the important effects involve species whose lifetimes are short compared to mixing times in the atmosphere, the further advancement of our understanding of the effects of these species requires the development of three-dimensional models. The development of 3-D models has been limited because of the lack of computer resources, the lack of relevant observations, and the lack of funding. However, with the development of the US Global Change Program and with the increased speed and availability of today's computers it is now possible to build models capable of describing the effects of these shorter-lived pollutants on a global basis. The Atmospheric Microphysics and Chemistry group has focussed on the development of three-dimensional Lagrangian models capable of running in a coupled mode with a climate model, as a tool for understanding the atmospheric cycles of these species. We have developed a Lagrangian chemistry model that is capable of running interactively with a global general circulation model. Distinct versions of the Lagrangian model with varying degrees of sophistication have been used to treat different chemical cycles. Additional funding is needed to extend capabilities to treat the full suite of species necessary to understand ambient aerosol concentrations and the effects of aerosols on climate. 15 refs., 3 figs., 1 tab.

47544 **Unvented space heaters and appliances.** Clarkin, M.E. (Camroden Associates, Inc., Rome, NY (USA)); Davis, B. pp. 27 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288--: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This workshop discusses pollutants released from the use of unvented combustion appliances in the home and the health effects of these pollutants. Ramifications of the use of these appliances interest building managers, weatherization program operators, and others concerned with the indoor air quality issue. Alternative appliance use and pollutant abatement techniques are presented. As a result of this workshop, participants will: (1) Understand the pollutants of unvented combustion appliances and their health effects; (2) Realize some of the ramifications of this information for weatherization programs; (3) Understand the possible alternatives to using unvented heaters or how to use them with greater safety.

47545 **Source-receptor relationships and control strategy formulation.** Streets, D.G. (Argonne National Laboratory, Energy and Environmental Systems Div., Argonne, IL (US)). pp. 165-182 of Acid rain: The relationship between sources and receptors. White, J.C. Elsevier Science Pub. Co., Inc., New York, NY (USA) (1988). (CONF-861268--: 3. annual conference on acid rain: the relationship between sources and receptors, Washington, DC (USA), 3-4 Dec 1986).

This paper discusses the importance of the source-receptor relationship to formulation of a control strategy. The author distinguished three types of strategy: emissions-optimized, in which one seeks to reduce emissions wherever they are greatest; cost-optimized, in which one seeks to reduce emissions wherever it is cheapest to do so; and deposition-optimized, in which one seeks to reduce emissions wherever it will lead to the most cost-effective reduction in deposition at a particular receptor site or set of sites. This third strategy is the one that takes advantage of source-receptor relationships. Proposals introduced to Congress are presented.

47546 **The impact of add-on catalytic devices on pollutant emissions from unvented kerosene heaters.** Apte, M.G. (Lawrence Berkeley Laboratory, CA (USA)); Traynor, G.W.; Froehlich, D.A.; Sokol, H.A.; Porter, W.K. *Journal of the Air and Waste Management Association (USA)*, 39(9): 1228-1230 (Sep 1989). DOE Contract AC03-76SF00098.

Many studies have documented pollutant emission rates from kerosene heaters. Carbon monoxide (CO), carbon dioxide (CO_2),

nitric oxide (NO), nitrogen dioxide (NO_2), formaldehyde (HCHO), suspended particles, and semivolatile and nonvolatile organic compounds, including some nitrated and non-nitrated polycyclic aromatic hydrocarbons, can be emitted by kerosene heaters. Recently, several add-on catalytic devices designed to reduce some pollutant emissions have become commercially available. The tests described here were designed to measure the impact of these devices on pollutant emissions from unvented kerosene heaters. Emissions of CO, NO, NO_2, HCHO, and total suspended particles were investigated in this study. In addition, analyses of particulate sulfur and chromium were conducted for some tests.

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Refer also to citation(s) 46396, 46585, 46586, 46607, 46608, 46610, 46611, 46612, 46668, 46669, 46701, 46702, 46709, 46710, 46712, 46713, 46714, 46715, 46721, 47280, 47504, 47508, 47574, 47575, 47576, 47577, 47579, 47580, 47581, 47582, 47584, 47585, 47586, 47587, 47588, 47591, 47592, 47593, 47594, 47595, 47600, 47602, 47603, 47604, 47606, 47607, 47611, 47612, 47613, 47618, 47653, 47702

47547 (CDTN-DERL-PD–026/81) **Radiometric survey in sites of NUCLEMON deposits in Interlagos - Sao Paulo.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1981. 6p. (In Portuguese). Order Number DE90639584. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

This report presents the radiometric survey in sites and storage shed of NUCLEMON deposits in Interlagos/SP in order know if the radioactive materials could be removed. (C.M.).

47548 (CDTN-DERL-PD–038/82) **Underground flux studies in waste basin of CIPC using natural and artificial tracers (volume I).** Minardi, P.S.P. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Oct 1982. 104p. (In Portuguese). Order Number DE90639591. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

This report presents studies to be done in wastes basin of CIPC in order to verify the contamination possibility of Rio das Antas basin, by infiltration in subsoil, of liquid wastes proceeding from mineral and industrial complex of Pocos de Caldas to be done up to February/82. (author).

47549 (DOE/BP–1307) **Northern Cascades corridor availability study: [Final] draft.** USDOE Bonneville Power Administration, Portland, OR (USA). May 1990. 180p. Sponsored by U.S. DOE Bonneville Power Administration. Order Number DE90017093. Source: NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This Northern Cascades Corridor Availability Study is a joint project of Bonneville Power Administration (BPA), the US Forest Service (FS), and the Bureau of Land Management (BLM). It was undertaken in response to Congressional mandates that the Federal agencies find ways to implement multi-use corridors in order to avoid the proliferation of rights-of-way. It was also intended to identify the availability of corridors in an area where land use and physical constraints were previously unknown. The Northern Cascades Corridor Availability Study report is a planning document and not a project decision document. It is intended to provide long-range corridor planning information for use by land management agencies and utility planners. Any project which may require the use of one of the corridors identified in this study will be subject to federal, state, and local siting and permitting requirements. Project siting processes would be subject to public involvement. This study evaluates FS and BLM lands, as well as other private and public lands, for corridor availability, and seeks to provide detailed information on constraints and opportunities for over 4,432 miles of existing corridors and over 35,000 square miles of existing corridors and over 35,000 square miles of the State of Washington. Evaluation criteria developed for the study were divided into exclusion areas where facilities cannot be built, three categories of avoidance areas, and engineering suitability for use of existing or unoccupied corridors. Data collected for the study were mapped and stored in BPA's Geographic Information System, and analyzed through Arc/Info software. 21 refs., 22 figs.

47550 (IS–4922) **Ames Laboratory site environmental report, calendar year 1988.** Mathison, L.K. Ames Lab., IA (USA). May 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90016714. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The summarized data and conclusions from the Ames Laboratory environmental monitoring program are presented in this Annual Site Environmental Report. Ames Laboratory is located on the campus of Iowa State University (ISU) and occupies several buildings owned by the Department of Energy. A study is being conducted to identify environmental sampling methods which can characterize and separate the impact of Ames Laboratory's campus activities and that of ISU. This will enable the Laboratory to determine what possible impact it's operations may be having to the environment, if any. Two Pollution Abatement projects were begun in 1988. They were: removal of thorium contaminated soil resulting from a historical release of thorium at the Laboratory, to the Ames, Iowa Water Pollution Control (sewage) Plant and demolition of a small "Blockhouse" constructed of concrete block which had been used for low level radioactive waste handling. The contaminated soil has been removed and transported to Hanford, WA for disposal. A final site radiological survey for thorium is pending. In addition, contaminated debris was transported to Hanford, WA for disposal and a final site survey is pending. 7 refs., 4 figs., 1 tab.

47551 (PB–90-228917/XAB) **Health assessment for American Smelting and Refining, Tacoma, Washington, Region 10 (addendum to). Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 25 Sep 1989. 7p. Source: NTIS, PC A02/MF A01.

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared a Preliminary Health Assessment for the American Smelting and Refining Company (ASARCO) site on January 2, 1989. Since that time, the authors have received two additional reports on the site - the Endangerment Assessment (1) and the Engineering Evaluation/Cost Analysis of Removal Action Alternatives (2) The addendum will specifically address public health concerns related to the contamination of off-site soils with arsenic.

47552 (PB–90-234675/XAB) **Background document for Third Third wastes to support 40 CFR Part 268 land-disposal restrictions. Final rule. Third third waste volumes, characteristics, and required and available treatment capacity.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. May 1990. 1018p. Source: NTIS, PC EE99/MF E99.

Set includes PB–90-234683 through PB–90-234717.

A separate abstract is included for the 4 volumes of this set.

47553 (PB–90-243957/XAB) **Health assessment for E. I. du Pont (County Road X-23)/McCarl Farm Site, Lee County, West Point, Iowa, Region 7. CERCLIS No. IAD980685804. Preliminary report.** Iowa Dept. of Public Health, Des Moines, IA (USA). 11 Jun 1990. 18p. Source: NTIS, PC A03/MF A01.

The E.I. DuPont site is proposed to be listed by the U.S. Environmental Protection Agency (EPA) on the National Priorities List (NPL). The site includes two different locations at which contaminants are present, known as the McCarl Farm and the James Baier Farm. The McCarl Farm was used for approximately one year (1952 to 1953) to dispose of paint wastes generated by the E.I. DuPont de Nemours and Company, Incorporated (DuPont), Fort Madison, Iowa. The site was utilized concurrently with the James Baier Farm, primarily during rainy periods when it was too wet to gain access to the James Baier Farm. Based on the available information, this site is considered to be of potential public health concern because of the risk to human health caused by the possibility of exposure to hazardous substances via contaminated groundwater and soil on-site. Although there does not appear to be any potential public health threat at this time, future migration of groundwater contaminants and changes in land use practices and activities on-site may pose a risk to human health.

47554 (PB–90-245721/XAB) **Action of a fluoranthene-utilizing bacterial community on polycyclic aromatic hydrocarbon components of creosote.** Mueller, J.G.; Chapman, P.J.; Pritchard, P.H. Environmental Protection Agency, Gulf

Breeze, FL (USA). Environmental Research Lab. ©1989. 9p. (EPA–600/J-89/425). Source: NTIS, PC A02/MF A01.

Pub. in Applied and Environmental Microbiology, Vol. 55, No. 12, 3085-3090(Dec 1989).

Cultures enriched by serial transfer through a mineral salts medium containing fluoranthene were used to establish a stable, 7-membered bacterial community from a sandy soil highly contaminated with coal-tar creosote. This community exhibited an ability to utilize fluoranthene as sole carbon source for growth as demonstrated by increases in protein concentration and changes in absorption spectra when grown on fluoranthene in liquid culture. Biotransformation of other polycyclic aromatic hydrocarbons (PAHs) were verified by demonstrating their disappearance from an artificial PAH mixture using capillary gas chromatography. When grown on fluoranthene as sole carbon source and subsequently exposed to fluoranthene plus 16 additional PAHs typical of those found in creosote, this community transformed all PAHs present in this defined mixture. Continued incubation resulted in extensive degradation of the remaining 4 compounds.

47555 (PB–90-247099/XAB) **Health assessment for Sealand Limited Site, Mt. Pleasant, New Castle County, Delaware, Region 3. CERCLIS No. DED981035520. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 25 Jun 1990. 14p. Source: NTIS, PC A03/MF A01.

The Sealand Limited (Sealand) site has been proposed by the U.S. Environmental Protection Agency for the National Priorities List. Sealand is located in Mt. Pleasant, New Castle County, Delaware. The site, which is unfenced, was used as an animal-fat rendering facility and a waste-oil recycling operation. The area around Sealand is mostly rural residential. No municipal or public water supplies are located within a 3-mile radius of the site; ground water is the primary source of domestic water supply in the area. Approximately 300 persons live within a 1-mile radius of the site. Based on the information reviewed, the Agency for Toxic Substances and Disease Registry has concluded that this site is of potential public health concern because humans may be exposed to hazardous substances at concentrations that could result in adverse health effects. Human exposure to polynuclear aromatic hydrocarbons and metals may occur via ingestion of, inhalation of, and dermal contact with contaminants in soils, ground water, and air. Additional information is needed to more fully evaluate the releases and migration of contaminants and their resulting levels at points of potential human exposure.

47556 (PNL-SA–18054) **Model evaluation of the assumptions used in valley energy budgets.** Bader, D.C. (Pacific Northwest Lab., Richland, WA (USA)); Horst, T.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-9006111–8: Conference on mesoscale processes and mountain meteorology, Boulder, CO (USA), 25-29 Jun 1990). Order Number DE90016561. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the 1984 ASCOT field studies in Brush Creek, Colorado, extensive measurements of the nocturnal wind and temperature fields were made that subsequently were used to develop a thermal energy budget of the valley flow system. The calculated thermal energy budgets did not balance, however. Possible explanations for the discrepancies are that the measurements contained significant errors and that one or more of the several assumptions used in computing the budget terms was not valid. To determine the reasons for the imbalances, valley thermal energy budgets were calculated from numerical simulations of valley drainage flow using a three-dimensional dynamical mesoscale model. This paper discusses this model. The model uses and idealized version of the valley topography to simplify the calculations and more clearly reveal the small-scale processes that determine the various contributions to the budgets. The model simulation had no externally imposed wind field. 2 refs., 5 figs.

47557 (SRO-NERP–19) **Vegetation of the Savannah River Site: Major community types.** Workman, S.W.; McLeod, K.W. Savannah River Ecology Lab., Aiken, SC (USA). 1990. 137p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-76SR00819. Order Number DE90017254. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The eight major plant community types of the Savannah River Site (SRS) are distributed along topographic and moisture gradients and strongly controlled by local management practices. Communities range from sandhill communities in the xeric uplands to bottomland or swamp forests in low-lying areas subject to periodic flooding. The variety of community types and extensive land area (78,000 ha) of the SRS provides habitat for a diversity of plant species. As a National Environmental Research Park, the SRS provides an area for study of man-altered systems in relation to natural systems. A site-wide Set-Aside Areas program designates specific parcels of land representing different community types on the SRS. These areas conserve habitat for plants and wildlife, including some endangered, threatened and rare species. This document provides descriptions, including community characteristics and species composition, for the eight major vegetation communities of the SRS (old field, sandhill, upland hardwood, pinelands, bottomland, swamp, Carolina bay and fresh water). Species lists of tree, shrub, vine, herbaceous, and lower plant species of the SRS, by community type, were compiled from existing literature, herbarium information, and solicited additions from researchers familiar with SRS vegetation; these are provided in appendices. 130 refs., 19 figs.

47558 (UBA-FB–89-157) **Analysis of selected soil and plant samples for dioxins and furans.** Hagenmaier, H.; Brunner, H.; Knapp, W.; Weberruss, U. Tuebingen Univ. (Germany, F.R.). Inst. fuer Organische Chemie; Umweltbundesamt, Berlin (Germany, F.R.). Jul 1989. 73p. (In German). Contract UFOPLAN-Nr. 10701010. Source: Copy held by UB/TIB Hannover.

Soil samples from agricultural test areas with high sewage sludge dosages between 1976 and 1982 and corresponding control samples, as well as plant samples were analyzed for polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF). Soil samples with sewage sludge application show a relatively high concentration of PCDD/PCDF (maximum 21420 ng/kg for the sum of PCDD/PCDF, corresponding to 261 ng/kg TCDD-toxicity equivalents). Increased PCDD/PCDF-concentrations are found in clover and especially in lettuce - most likely not due to systemic uptake - but not in wheat, potatoes and radish. Intensive agricultural use of sewage sludge can lead to PCDD/PCDF levels above the discussed values of 5 ng/kg toxicity equivalents (TE) for unlimited agricultural use and 40 ng/kg TE for limited agricultural use in a rather short time period. (orig.) With 36 refs., 22 tabs., 14 figs.

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Refer also to citation(s) 46588, 46591, 46592, 46594, 46595, 46598, 46600, 46601, 46607, 46608, 46611, 46666, 46668, 46763, 46764, 46765, 46766, 46876, 47280, 47504, 47508, 47509, 47550, 47552, 47553, 47555, 47697, 47702, 47724, 47727, 47740

47559 (AD-A–222261/0/XAB) **Determination of fission products and actinides in the Black Sea following the Chernobyl accident. Technical report.** Buesseler, K.O.; Casso, S.A.; Hartman, M.C.; Livingston, H.D. Woods Hole Oceanographic Institution, MA (USA). 1990. 15p. Contract N00014-85-C 0715, Grant NSF-OCE87-00715. (WHOI-CONTRIB–6798). Source: NTIS, PC A03/MF A01.

Pub. in Jnl. of Radioanalytical and Nuclear Chemistry, Articles, Vol. 138, No. 1, 33-47(1990).

A wide variety of man-made radioactive elements have been introduced into the environment as a consequence of the development of atomic power and nuclear weapons technology. These radiotracer releases have been studied for a number of reasons. In oceanography, for example, considerable effort has been spent studying the distribution and fate of fallout radionuclides from atmospheric nuclear weapons testing programs and from radioactive discharges from nuclear fuel reprocessing plants. Such tracer studies can provide information on the mixing rates of oceanic water masses, biological uptake rates of trace elements, vertical scavenging and removal processes, dating of samples, geochemical cycling of trace elements, and other processes. The Chernobyl nuclear power station accident in April of 1986 created a new source of fallout radioisotopes to the environment and, immediately following the Chernobyl accident, considerable effort was spent

determining the activities of a wide variety of Chernobyl fallout radionuclides in the environment (4, 5, 6, and many others).

47560 (AD-A–222389/9/XAB) **Combined waste-water characterization and hazardous-waste survey, Davis-Monthan AFB, Arizona. Final report, 19 June-7 July 1989.** Binovi, R.D.; Hedgecock, N.S.; Attebery, C. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). Apr 1990. 268p. (AFOEHL–90-045EQ00047DSC). Source: NTIS, PC A12/MF A02.

A wastewater characterization and hazardous waste management survey was conducted by members of the AFOEHL Environmental Quality Division. The purpose of the survey was to find sources of phenols in the wastewater and provide basic data for the subsequent design of a wastewater pretreatment plant. Flow measurements were taken at 17 locations and wastewater samples taken at 60 locations. A total of 39 shops were assessed for industrial waste disposal practices. Recommendations include: (1) some separators need cleaning and proper disposal of the contents, (2) action to change phenol analysis method for compliance monitoring should continue, (3) continue restrictions on use of compounds containing forms of phenols, (4) design of pretreatment system should include processes for the removal of metals and priority organic compounds, and (5) eliminate the discharge of Rinsolve 140 to the sanitary sewer system, as it may be contributing to the apparent phenolic concentrations determined by EPA Method 420.

47561 (AD-A–222447/5/XAB) **Surface changes in well-casing pipe exposed to high concentrations of organics in aqueous solution. Special report.** Taylor, S.; Parker, L. Cold Regions Research and Engineering Lab., Hanover, NH (USA). Mar 1990. 19p. (CRREL-SR–90-7). Source: NTIS, PC A03/MF A01.

This preliminary study was undertaken to assess how the surface structural characteristics of four common well casing materials-polyvinyl chloride (PVC), Teflon (polytetrafluoroethylene, PTFE), stainless steel 304 (SS304) and stainless steel 316 (SS316)-are affected by exposure to an aqueous solution containing tetrachloroethylene, toluene, p-dichlorobenzene and 0-dichlorobenzene in concentrations near their solubility. Casing samples that had been exposed to a test solution for 1 week, 1 month and 6 months were examined with a scanning electron microscope (SEM) and compared with control samples placed in well water for an equivalent time period. Pieces of casing that had not been placed in any aqueous solution were also examined and are assumed to be representative of the initial structure of the casing's surface. These organics are of concern at hazardous waste sites, where they often occur in ground water. The observations indicate that the surface characteristics of PVC, SS316 and SS304 did not change when exposed to the organic aqueous solution. The surface variability and lack of distinguishing features at high magnification made it difficult to tell if the PTFE surface had changed. However, no obvious changes (swelling, pitting etc.) were seen.

47562 (BSE-PROC–22, pp. 11-25) **Input of petroleum hydrocarbons to the Danish sea area and levels occurring in the environment.** Granby, K. (Marine Pollution Laboratory, Charlottenlund (Denmaek)); Jensen, K.; Joergensen, K. F. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

An assessment of the chronic oil pollution in the Danish waters is currently being made. In this paper an estimate of the oil pollution load from all sources is presented. Bivalves (Mytilus edulis) and sediments have been used as monitors of the marine pollution and possible sources and origins of the hydrocarbons are discussed. The sediments and mussels collected in the Sound near Copenhagen and the mussels from the Kattegat Coast off Limfjorden show the highest PHC contents.

47563 (BSE-PROC–22, pp. 51-52) **A seasonal multigeographical sediment trap experiment on input of polycyclic aromatic hydrocarbons in archipelago waters (Baltic proper).** Broman, D. (University of Stockholm, Stockholm (Sweden). Department of Zoology); Ganning, B.; Colmsjoe, A.; Naef, C.; Zebuehr, Y. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Abstract only. BALTIC SEA/water pollution; COASTAL WATERS/polycyclic aromatic hydrocarbons; SEDIMENTS; SWEDEN; SEASONAL VARIATIONS; EMISSION; EXHAUST GASES

47564 (BSE-PROC–22, pp. 53) **GCMS-identification of petroleum-like hydrocarbons in plankton, seston and bottom surface sediment.** Broman, D. (University of Stockholm, Stockholm (Sweden). Department of Zoology); Ganning, B.; Colmsjoe, A. Naef, C.; Zebuehr, Y.; Oestman, C. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

Abstract only. HYDROCARBONS/gas chromatography; SURFACE WATERS/water pollution; PETROLEUM; HYDROCARBONS; MASS SPECTROSCOPY; SEDIMENTS; PLANKTON

47565 (BSE-PROC–22, pp. 54-67) **Hydrocarbon biodegradation in aerobic marine sediments.** Hoepner, Th.; Kant, U.; Kiesewetter, K.; Michaelsen, M.; Tegelkamp, B. Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1987. (CONF-8611312–: Seminar on oil pollution questions, Norrkoeping (Sweden), 19-20 Nov 1986). In *Oil pollution questions.* Order Number DE90518715. Source: NTIS (US Sales Only), PC A12/MF A01.

This report deals with hydrocarbon biodegradation in tidal sediments and draws conclusions on practical measures of oil biodegradation support. Results have been obtained from in situ experiments at tidal flats, from laboratory experiments using fresh sediments as well as from laboratory experiments using a standardized and inoculated sediment mixture. At least the first step of hydrocarbon biodegradation, the initial hydroxylation, is obligatorily oxygen dependent. Even if nitrate or sulphate serve as electron acceptors in sediments, these reactions are restricted to the degradation of the first oxygen containing intermediates (alcohols, phenols, carbonic acids). A biodegradation absolutely independent of oxygen cannot be expected. In anoxic sediments a hydrocarbon degradation is extremely slow or absent. Whether this also holds for the degradation of the oxygen-containing intermediates were examined. It is obvious that these biochemical considerations are ecologically unimportant for practical application.

47566 (CNIC–00280) **Survey and assessment of levels of natural radionuclides in natural waters in China.** Liu Yulan (Ministry of Public Health, Beijing, BJ (China). Lab. of Industrial Hygiene). China Nuclear Information Centre, Beijing, BJ (China). Dec 1988. 8p. (In Chinese). (LIHMPH–0002). Order Number DE90638164. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The natural radionuclides (U, Th, ^{226}Ra and ^{40}K) contents in natural waters were determined during the period of 1982 ≈ 1987. 146 samples of waters were collected from Yangtze River, Yellow River, Pearl River and lakes in China. Radioactivity contents and characteristics of distributions of the radionulides U, Th, ^{226}Ra and ^{40}K are given. The highest value of U contents is 35.9 x 10^{-2} Bq/L, the lowest 1.33 x 10^{-2} Bq/L, and the average 9.20 x 10^{-2} Bq/L in Yellow River; the highest value is 3.75 x 10^{-2} Bq/L, the lowest 0.23 x 10^{-2} Bq/L, and the average 2.00 x 10^{-2} Bq/L in Yangtze River; the highest value is 2.73 x 10^{-2} Bq/L, the lowest 0.30 x 10^{-2} Bq/L, and the average 1.40 x 10^{-2} Bq/L in Pearl River. The general characteristics of distributions of U in the rivers is in Yellow River > in Yangtze River > in Pearl River. The contents and distributions of ^{226}Ra and ^{40}K are: in Yellow River (1.34 x 10^{-2} Bq/L) > in Pearl River (0.94 x 10^{-2} Bq/L) in Yangtze River (0.69 x 10^{-2} Bq/L), for ^{226}Ra; and for ^{40}K, in Yellow River (26.72 x 10^{-2} Bq/L) > in Yangtze River (22.86 x 10^{-2} Bq/L) > in Pearl River (3.00 x 10^{-2} Bq/L). Natural radionuclides contents in lakes are concurrent with in the rivers, Yangtze and Pearl, but lower than in Yellow River.

47567 (CNIC–00285) **Assessment and the levels of radioactivity of natural radionuclides in drinking waters in**

China. Liu Yulan (Ministry of Public Health, Beijing, BJ (China). Lab. of Industrial Hygiene). China Nuclear Information Centre, Beijing, BJ (China). Mar 1989. 10p. (In Chinese). (LIHMPH–0003). Order Number DE90638165. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

In order to assess the levels of radioactivity of natural radionuclides in drinking waters and to estimate the internal doses of the population of China from ingestion, 1650 samples of waters were collected from normal radiation background areas of 28 provinces or autonomous regions of China. Radioactivity levels of U, Th, ^{226}Ra and ^{40}K in drinking waters were determined. The levels and the characteristics of distribution of 4 radionuclides are given. The results show that radioactivity levels in the southeast China are lower than in the north and northwest China. The average radioactivity levles of the 4 radionuclides in China close to the average levels given in UNSCEAR 1986 report. The result of estimation of internal doses from ingestion in the population of China is below the corresponding results given in UNSCEAR 1986 report, but near the result given by ICRP.

47568 (DOE/NV/10845–3) **Stable isotopic study of precipitation and spring discharge on the Nevada Test Site.** Ingraham, N.L. (Nevada Univ., Las Vegas, NV (USA). Water Resources Center); Jacobson, R.L.; Hess, J.W.; Lyles, B.F. Nevada Univ., Las Vegas, NV (USA). Water Resources Center; Nevada Univ., Reno, NV (USA). Water Resources Center. Jul 1990. 55p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-90NV10845 ;AC08-81NV10162. Order Number DE90017094. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Precipitation was collected in southern Nevada (on the Nevada Test Site) on a semi-regular monthly basis at 41 locations for six years for stable isotopic analysis. The precipitation record shows two time-based regimes. For the first three years of collection, the precipitation was highly variable with several large events and several dry periods. During the last three years of collection, the precipitation was much more even with no large events. However, there is no correlation between the variability in the amount of precipitation and the stable isotopic composition of precipitation. In addition, the oxygen isotope composition and discharge of two springs, Whiterock Spring and Cane Spring, issuing from perched water tables, were monitored for five years in a similar time frame as for the precipitation. 17 refs., 42 figs., 3 tabs.

47569 (DOE/RL–90-36) **Quarterly report of RCRA groundwater monitoring data for period April 1, 1990 through June 30, 1990.** Westinghouse Hanford Co., Richland, WA (USA). Geosciences Group. Aug 1990. 168p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90016429. Source: NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Hanford Site interim-status groundwater monitoring projects are conducted as either background, indicator parameter evaluation, or groundwater quality assessment monitoring programs as defined in the Resource Conservation and Recovery Act of 1976 (RCRA) (EPA 1986a); 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, as amended (EPA 1988b). This submittal provides data obtained from groundwater monitoring activities for April 1, 1990 through June 30, 1990. 18 refs., 20 figs., 34 tabs.

47570 (DOE/SR/18049–2) **Composition of phytoplankton communities and their contribution to secondary productivity in Carolina Bays on the Savannah River Plant: Year two report.** Williams, J.B. South Carolina State Coll., Orangeburg, SC (USA). Dept. of Natural Sciences. Aug 1990. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract FG09-88SR18049. Order Number DE90017262. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This three-year collaborative project with Savannah River Ecology Lab (SREL) has an overall goal to determine the importance of phytoplankton (microscopic algae) as a component of the food chain base in SRS Carolina Bays. The importance of zooplankton (microscopic crustacean herbivores) to the early life stages of amphibians in these Carolina Bays has been determined by previous investigators and ongoing SREL studies. Our project is testing hypotheses that phytoplankton compose the most important part of zooplankton diets in SRS bays. Considerable progress has been made on each of the YEAR TWO proposal objectives. Proposed work for one of the objectives will not be completed by the end of the project year due to the high work volume required for the stable isotope sampling. All sampling for primary productivity and stable isotope analyses has been completed. However, scheduled samples for the hotter summer temperatures during July were not collected due to the fact that Flamingo, Ellenton, and Rainbow Bays had already dried up. Progress for each of the Proposal Year One objectives is summarized in this report along with summaries for supplemental objectives. Detailed discussions of methodology and results are also found in the report. 11 refs., 6 figs.

47571 (LA-UR–90-2843) **Analysis of contaminant movement at different experimental scales.** Springer, E.P. (Los Alamos National Lab., NM (USA)); Newman, B.D.; Stauffer, T.B.; Antworth, C.A.; MacIntyre, W.G. Los Alamos National Lab., NM (USA). [1990]. 31p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-9010186–1: HAZTECH international 1990 conference, Pittsburgh, PA (USA), 2 Oct 1990). Order Number DE90016486. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two experimental approaches were used to examine transport in saturated porous media. One design, the box experiment, allowed two-dimensional sampling of the solute plume. The more traditional column design was one-dimensional with sample collection only at the effluent end. A total of three box and two column experiments were conducted. The method of moments was used to analyze plume behavior in both experiments. Comparison between the experiments were made using the moments. For similar porous materials the same retardation was observed despite an order of magnitude different in velocities. Data from the one-dimensional column experiments were used to estimate dispersivities that were used to predict the behavior in the multidimensional box experiment. Results indicated that velocity information from the box experiment was needed in order to attain an adequate prediction of its response. 8 refs., 9 figs., 12 tabs.

47572 (PB–90-215450/XAB) **Determination of trace elements in waters and wastes by inductively coupled plasma - mass spectrometry: Method 200.8. Version 4.0.** Long, S.E.; Martin, T.D. Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring Systems Lab. Sep 1989. 46p. Source: NTIS, PC A03/MF A01.

The method provides procedures for the determination of dissolved elements in ground waters, surface waters and drinking water supplies. It may also be used for the determination of total recoverable element concentrations in these waters as well as wastewaters, sludges and solid waste samples. The method describes the multi-element determination of trace elements by inductively coupled plasma-mass spectrometry (ICP-MS).

47573 (PB–90-239880/XAB) **Chesapeake Bay ambient toxicity-assessment workshop report.** Krome, E.C. Maryland Univ., College Park, MD (USA). May 1990. 182p. Source: NTIS, PC A09/MF A01.

Proceedings of a workshop conducted in Annapolis, Maryland, July 25-27, 1989. Its purpose was to provide resource managers with the necessary information to better assess and evaluate the significance of toxic contaminants as causes of mortality and impaired growth and reproduction of Bay organisms. Plenary presentations addressed population risk assessment; sediment toxicity assessment; whole organism toxicity assessment; and suborganismal toxicity assessment. Subsequent group sessions developed conclusions, findings and recommendations.

47574 (PB–90-241944/XAB) **Health assessment for Brantley Landfill, Island, Kentucky, Region 4. CERCLIS No. KYD980501013. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 20p. Source: NTIS, PC A03/MF A01.

The Brantley Landfill site, located in Island, Kentucky, in McLean County, has been proposed by the U.S. Environmental Protection Agency for addition (Update 7) to the National Priorities List. Ammonia has been detected at levels of concern; hydrogen sulfide, hydrogen, and methane may also be of concern. The population of Island is approximately 500, and approximately 200 persons live

within one-quarter mile of the site. The nearest residence is within 100 to 200 feet from the property. Area residents have complained about odors, and State personnel have cited the landfill operator for excessive fugitive emissions. Wastes/soils, groundwater, subsurface gases, and ambient air may be substantive environmental pathways for site-related contaminants. The Agency for Toxic Substances and Disease Registry has concluded that the site is of potential public health concern. Human exposure to site-related contaminants might be occurring through use of area-wide private and public water supplies. However, groundwater monitoring data are not available to confirm this. On-site intruders and future remedial workers potentially may be exposed–via inhalation, ingestion, or dermal contact–to contaminants in the waste materials and evolving gases. Off-site, residents also may be exposed to contaminants through inhalation of ambient air and also to subsurface gases if the gases migrate below ground and accumulate in homes. Subsurface gases could pose a threat of physical injury (explosion) if they collect on-site or in residences off-site at levels at which ignition or explosion may occur.

47575 (PB–90-241951/XAB) **Health assessment for Murray-Ohio Dump, Lawrenceburg, Lawrence County, Tennessee, Region 4. CERCLIS No. TND980728836. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 11p. Source: NTIS, PC A03/MF A01.

The Horseshoe Bend Dump site has been proposed for the National Priorities List by the U.S. Environmental Protection Agency. The site is contained in 12 acres on Horseshoe Bend, a sharp, narrow bend of Shoal Creek in Lawrence County, Tennessee, approximately 1.5 miles southwest of Lawrenceburg. The site consists of approximately 5 acres in the extreme northern tip of the bend on low-lying terrain immediately adjacent to Shoal Creek and the actual disposal pits cover areas totalling about 2 acres. The Horseshoe Bend Dump site is located in a rural, residential area. About 19,000 persons depend on a municipal water system whose intakes (ground water and surface water) are located about 1 mile from the site. Based on the information reviewed, the Agency for Toxic Substances and Disease Registry has concluded that the site is of potential public health concern because humans may be exposed to hazardous substances at concentrations that may result in adverse health effects. As noted in the Human Exposure Pathways Section below, exposure to lead could occur via ingestion of contaminants in surface water, sediment, soil, ground water, and food-chain entities; inhalation of contaminants in air; and dermal contact with contaminants in surface water, sediment, soil, and ground water.

47576 (PB–90-241969/XAB) **Health assessment for Fort Hartford Coal Stone Quarry, Olaton, Kentucky, Region 4. CERCLIS No. KYD980844625. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 20p. Source: NTIS, PC A03/MF A01.

The Fort Hartford Stone Quarry site, an underground mine located near Olaton, Kentucky, in Ohio County, has been proposed by the U.S. Environmental Protection Agency for addition (Update 7) to the National Priorities List. Mine tunnels contain piles of wastes from aluminum smelting. Ammonia and lead have been detected at levels of concern; hydrogen sulfide, methane, hydrogen, and aluminum may also be of concern. The lead may not be associated with the wastes being managed on-site. Approximately 15 persons reportedly live within one-half mile of the site, and the nearest residence is about 1,500 feet to the southeast. Olaton, a small community of about a dozen houses, is 2 miles to the southeast; approximately 1,400 persons reside within 4 miles. Local fishermen have complained about odors, and citizens have expressed concerns about mine tunnels and gases affecting a school now under construction about 2 miles from the site. Wastes, groundwater, subsurface gases, and ambient air may be substantive environmenal pathways for site-related contaminants. The site is of potential public health concern. Area residents may be exposed to site-related contaminants through use of groundwater from private water supply wells. On-site workers and future remedial workers potentially may be exposed–via inhalation, ingestion, or dermal contact–to contaminants in the waste materials and evolving gases. Persons off-site also may be exposed to contaminants through inhalation of ambient air and to subsurface gases if gases migrate below ground and accumulate within homes, businesses, and public buildings. Subsurface gases also could pose a threat of physical injury if they collect on-site or in buildings off-site at levels at which ignition or explosion may occur.

47577 (PB–90-241977/XAB) **Health assessment for US Nameplate Company, Mt. Vernon, Iowa, Region 7. CERCLIS No. IAD054758958. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 8 Jun 1990. 9p. Source: NTIS, PC A02/MF A01.

The U.S. Nameplate Company site is listed by the U.S. Environmental Protection Agency (USEPA) on the National Priorities List (NPL). U.S. Nameplate Company, Inc. manufactures nameplates by etching aluminum, brass, and stainless steel. Liquid wastes from the manufacturing processes are acidic and contain chromium, copper, fluoride, hydrochloric acid, hydrofluoric acid, and zinc. USEPA performed a sampling inspection at the site in July-August 1985 and August 1986. In July-August 1985 twenty lagoon sludge samples, three lagoon surface water samples, and three groundwater samples were collected and analyzed for total metals, volatile organics, fluorides, cyanides and chromium VI. The detection limit was 500 microg/l for lead and 50 microg/l for cadmium. The potential environmental pathways of concern are groundwater, soil, sediment, surface water, and air. The site is of potential public health concern because of the potential risk to human health resulting from the possible exposure to hazardous substances via ingestion, inhalation, and dermal contact of groundwater, soil, and surface water.

47578 (PB–90-242074/XAB) **Comparison of accuracy and completeness of data obtained from three types of automatic water-quality monitors. Water Resources Investigation.** Katzenbach, M.S. Geological Survey, Columbus, OH (USA). Water Resources Div. 1990. 72p. (USGS/WRI–89-4198). Source: NTIS, PC A04/MF A01.

Also available from Supt. of Docs.

A comparison of data (specific conductance, dissolved-oxygen concentration, temperature, and pH) collected by the U.S. Geological Survey flowthrough monitor, the U.S. Geological Survey minimonitor, and a self-contained commercial packaged-sensor system indicates that the data obtained by means of the flowthrough-monitor system were the most accurate and the most complete of the three systems. Minimonitors were installed at four sites in Ohio where U.S. Geological Survey flowthrough monitors were in operation. Two packaged-sensor systems also were assigned to each site and were alternated every two weeks. Detailed records were kept of field measurements, for comparison with monitor-system data from each instrument, and equipment problems that resulted in loss of data. Results of the comparisons show that the flow-through monitor gave the most accurate and the most complete data.

47579 (PB–90-243965/XAB) **Health assessment for Durham Meadows Site, Durham, Connecticut, Region 1. CERCLIS No. CTD001452093. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

The Durham Meadows site, Durham, Connecticut, has been proposed by the Environmental Protection Agency (EPA) for inclusion on the National Priorities List. Site investigations so far have centered on Merriam Manufacturing Company, an active facility that manufactures metal containers, boxes, and cabinets. Inappropriate disposal of paint and degreasing wastes has resulted in contamination of on-site soil and on-site and off-site groundwater with volatile organic chemicals (VOCs), including trichloroethylene, perchloroethylene, chloroform, and methylene chloride. There may be additional sources of VOCs in the area. The environmental medium and human pathway of primary public health importance is contaminated groundwater. Several private wells have been affected, resulting in remedial actions that initially included bottled water and finally carbon filtration. The entire town of Durham uses the bedrock aquifer for its water needs. Additionally, contaminated soil, surface water, and sediment may be of public health importance.

47580 (PB–90-243981/XAB) **Health assessment for Shaw Avenue Dump Site, Charles City, Iowa, Region 7 (amended). CERCLIS No. IAD980630560. Preliminary report.** Iowa Dept. of Public Health, Des Moines, IA (USA). 7 Dec 1988. 18p. Source: NTIS, PC A03/MF A01.

The Shaw Avenue Dump Site is listed by the U.S. Environmental Protection Agency (USEPA) on the National Priorities List (NPL). The 8-acre city dump site, consisting of three waste disposal areas, is located in the southeast edge of Charles City approximately 500 feet east of the Cedar River. The three disposal areas are no longer in use and have been covered with soil and are vegetated. Arsenic is the contaminant of concern at the Shaw Avenue Dump Site. On-site soil samples collected in 1981 contained concentrations of arsenic that ranged from 4-820 mg/kg. On-site groundwater, surface water, and air analyses were not conducted in previous investigations. From the available information, this site is considered to be of public health concern because of the potential risk to human health caused by possible exposure to hazardous substances via ingestion of groundwater, soil, and surface water; inhalation of fugitive dust; and dermal contact with soil, surface water, and groundwater.

47581 (PB–90-244005/XAB) **Health assessment for Atlas Tack Corporation, Fairhaven, Massachusetts, Region 1. CERCLIS No. MAD001026319. Preliminary report.** Massachusetts Dept. of Public Health, Boston, MA (USA). 4 Jun 1990. 10p. Source: NTIS, PC A02/MF A01.

The Atlas Tack Site was listed by the U.S. Environmental Protection Agency (EPA) on the National Priorities List (NPL) in 1990. From the mid 1940s to 1978, the Atlas Tack Company discharged industrial wastes in the form of organic solvents and metal filings to an unlined lagoon, which was adjacent to a saltwater tidal marsh. The lagoon contents were removed in 1985, transported to RCRA approved landfills and the lagoon was then backfilled. Factory operations ceased in 1985 and currently only a welding company operates on the site. Ground water monitoring, conducted in 1987, detected elevated levels of benzene, toluene, arsenic, cadmium, lead, chromium, and cyanide in monitoring wells drilled in various areas of the site. Subsequent to sludge removal, extraction procedure (EP) toxicity analyses were done on various soil samples recovered from the site. Based on the available information, this site is considered to be of potential public health concern caused by the possibility of exposure to hazardous substances. In accordance with CERCLA as amended, the Atlas Tack Co. site has been evaluated for appropriate follow-up studies. If data becomes available suggesting that human exposure to significant levels of hazardous substances is currently occurring, or has occurred in the past, ATSDR will reevaluate this site for any indicated follow-up.

47582 (PB–90-244013/XAB) **Health assessment for Mid-America Tanning Company, Sergeant Bluff, Woodbury County, Iowa, Region 7. CERCLIS No. IAD085824688. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 8 Jun 1990. 16p. Source: NTIS, PC A03/MF A01.

The Mid-America Tanning Company (MAT) Site is proposed to be listed by the U.S. Environmental Protection Agency (EPA) on the National Priorities List (NPL). Mid-America Tanning, now U.S. Tanning, is an animal hide processing plant located on 98.7 acres approximately five miles south of Sergeant Bluff, Woodbury County, Iowa. From June 1978 to the present, use of chromium has been extended to the entire process, which involves the treatment of approximately 1000 hides per day. The process utilizes trivalent chromium and produces waste sludge and liquids that are treated on-site at the company wastewater treatment facility. Based on the available information, this site is considered to be of potential public health concern because of the risk to human health caused by the likelihood of exposure to hazardous substances via groundwater, surface water and soil. Further environmental characterization and sampling of the site and impacted off-site areas during the Remedial Investigation and Feasibility Study (RI/FS) should be conducted to address the environmental and human exposure pathways discussed above and to further define the extent of contamination at the site.

47583 (PB–90-244021/XAB) **Health assessment for Darling Hill Dump, Lyndonville, Vermont, Region 1. CERCLIS No. VTD980520118. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

The Darling Hill Dump site is located northeast of the village of Lyndonville in northeast Vermont. Previous industrial waste disposal practices have apparently contaminated the underlying aquifer with trichloroethylene (TCE) and trans-1,2-dichloroethylene. This aquifer serves as a source for the municipal water supply system and for private wells. At present the municipal supply is contaminated with low levels of the contaminants, below the U.S. Environmental Protection Agency's (EPA) Maximum Contaminant Levels (MCLs). No adverse acute or chronic noncarcinogenic health effects are expected at this time from exposure to the contaminants in the municipal water supply. Because the contaminant levels in the municipal wells are rising and because upgradient contaminant levels indicate that the municipal water concentrations will continue to rise, decreasing TCE concentrations in the aquifer would help reduce the possibility of current or future health concerns. Potential for adverse health effects from on-site exposure exists, but cannot be evaluated because sampling data for soil and air are lacking.

47584 (PB–90-244047/XAB) **Health assessment for General Tire and Rubber Company, Mayfield, Kentucky, Region 4. CERCLIS No. KYD006371074. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 8 Jun 1990. 17p. Source: NTIS, PC A03/MF A01.

The General Tire & Rubber Co. (Mayfield Landfill) site, about 58 acres, is about 3 miles north of Mayfield, Kentucky, in central Graves County. The site has been proposed (Update 7) by the U.S. Environmental Protection Agency for addition to the National Priorities List. The site vicinity is a combined rural and residential setting. Wastes, in bulk and in containers, were disposed of at the site in trenches, and the landfill was capped when the facility was closed in 1984. Reportedly, wastes were principally rubber, fabric, wood, and paper but included oils, floor sweepings, 1,1,1-trichloroethane, naphtha, and toluene. Surface soils, sediment, surface water, subsurface gases, and ambient air may be substantive environmental pathways; but monitoring data are not sufficient to confirm this hypothesis. Using the information reviewed, the Agency for Toxic Substances and Disease Registry concludes that this site is of potential public health concern because humans may be exposed to hazardous substances at concentrations that may result in adverse health effects.

47585 (PB–90-244062/XAB) **Health assessment for Wilson Concepts of Florida, Inc., Pompano Beach, Florida, Region 4. CERCLIS No. FLD041184383. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 31 May 1990. 13p. Source: NTIS, PC A03/MF A01.

The Wilson Concepts site in northeastern Broward County, Florida has been manufacturing precision-machined parts since 1976. Waste cleaners, coolants, and lubricants were discharged directly onto the ground or overflowed from underground holding tanks subsequently spilling into an on-site dry-well storm drain. Carter and Crawley, a computer parts manufacturing company, began operation at the site on January 3, 1989. The 1986 analytic results reported in the NUS Site Screening Investigation (EPA, 1986) indicated that ground water on-site contains elevated concentrations. The soil and subsurface soil contamination levels did not exceed health concern screening levels. Based on the available information, this site is considered to be of potential public health concern because of the risk to human health caused by the possibility of exposure to hazardous substances via inhalation, ingestion, and dermal absorption of contaminants. The contaminants include vinyl chloride, 1,1,1-trichloroethane, cyanide, copper, 1,1-dichloroethene, lead, nickel, and 1,1-dichloroethane in ground water and 1,1,1-trichloroethane, 1,1-dichloroethane and 1,1-dichloroethene in storm water. To date, the population identified to be of greatest concern is on-site workers.

47586 (PB–90-244070/XAB) **Health assessment for Yakima Plating Company Site, Yakima, Washington, Region 10. CERCLIS No. WAD040187890. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 19p. Source: NTIS, PC A03/MF A01.

The Yakima Plating Company site is an active electroplating facility located in Yakima, Washington. The U.S. Environmental Protection Agency has proposed that the site be included on the National Priorities List, Update 7. The company has discharged waste water resulting from the electroplating processes to an on-site drainfield since 1962. Groundwater underlying the site is contaminated with several metals, including lead, chromium, and nickel. The surface soil is contaminated with chromium, nickel, 1,1,1-trichloro-2,2-bis-(p-chlorophenyl)ethane (DDT), and 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE). The site is considered to be of potential public health concern because humans may be exposed to hazardous substances via inhalation, ingestion, and dermal absorption of site-related contaminants.

47587 (PB–90-244088/XAB) **Health assessment for Agrico Chemical Company, Pensacola, Florida, Region 4. CERCLIS No. FLD980221857. Preliminary report.** Florida State Dept. of Health and Rehabilitative Services, Tallahassee, FL (USA). 31 May 1990. 14p. Source: NTIS, PC A03/MF A01.

The site of the former Agrico Chemical Company covers an area of approximately 30 acres. Based on the available information, it has been concluded this site is of potential public health concern because of the risk to human health from exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Environmental Contamination and Physical Hazards sections, human exposure to arsenic, chromium, fluoride, nitrate, and benzene may occur through contact with contaminated ground water; human exposure to fluoride may occur through contact with sediments and surface water in on-site impoundments. Air and edible plant and animal exposure pathways were not addressed in the information reviewed for this Preliminary Health Assessment.

47588 (PB–90-244096/XAB) **Health assessment for Crazy Horse Sanitary Landfill, Salinas, Monterey County, California, Region 9. CERCLIS No. CAD980498455. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 13p. Source: NTIS, PC A03/MF A01.

The Crazy Horse Sanitary Landfill was proposed for the National Priorities List by Update 7. The landfill is located in Salinas, Monterey County, California. The landfill is currently active and has been in operation since 1934. Currently, only nonhazardous materials are disposed of in the landfill, but during the 1970s, there was documented disposal of hazardous chemical wastes. Groundwater contamination with volatile organic compounds (VOCs) has been detected in on-site and off-site wells. Off-site properties with contaminated wells were purchased by the city of Salinas in 1987. The city of Salinas is currently operating a groundwater extraction and aeration treatment system to mitigate the groundwater contamination. There is currently no known off-site use of contaminated groundwater for potable or nonpotable purposes. The reported ambient air concentrations of VOCs at the landfill do not pose a health concern. There is currently no evidence that off-site residents or on-site workers are being exposed to site-related contaminants at levels of health concern. Remedial activities and periodic monitoring of groundwater and soil gases should be continued to protect public health.

47589 (PB–90-244104/XAB) **Health assessment for Holton Circle Ground Water Contamination Site, Londonderry, New Hampshire, Region 1. CERCLIS No. MHD981063860. Preliminary report.** New Hampshire Dept. of Health and Human Services, Concord, NH (USA). Environmental Health Risk Assessment Unit. 4 Jun 1990. 16p. Source: NTIS, PC A03/MF A01.

The Holton Circle Ground Water Contamination Site (Holton Circle Site), defined as a series of residential wells and one commercial well that have been contaminated with chloride and various volatile organic chemicals (VOCs) from an unidentified source, is listed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL). The contaminated wells that are considered part of the site lie along Holton Circle, a residential area in southwest Londonderry, New Hampshire. Sampling and analysis at the Holton Circle Site have been conducted by the NH WSPCC and NUS Corporation. Sampling by NH WSPCC has been limited to water supply well analyses for VOCs and inorganic analytes. Based upon the available information, the Holton Circle Ground Water Contamination NPL Site is considered to be of potential public health concern because of the risk to public health caused by potential exposure to hazardous substances at concentrations that may result in adverse health effects if exposure were to occur over an extended period of time. There do not appear to be any sources of acute health risks associated with the Holton Circle Ground Water Contamination Site. As noted in Section III, contaminants have been identified above acceptable levels in at least five residential wells. Consequently, it is recommended that investigations be initiated to identify and remediate the source, or sources, of ground water contamination.

47590 (PB–90-244120/XAB) **Health assessment for Madison County Sanitary Landfill, Madison, Florida, Region 4. CERCLIS No. FLD981019235. Preliminary report.** Florida State Dept. of Health and Rehabilitative Services, Tallahassee, FL (USA). 31 May 1990. 13p. Source: NTIS, PC A03/MF A01.

The Madison County Sanitary Landfill is located in a rural area approximately 1.2 miles north of the City of Madison, Florida, at the southeast junction of Rocky Ford Road and Jestlamb School Road. The site covers 133 acres, of which 80 acres has been used for municipal, residential, agricultural, and industrial waste disposal. Active landfill operations are occurring in the southeast corner of the site with the final cell being filled. The following compounds that were detected in ground water at levels of probable public health concern from monitoring wells and surface samples of the landfill are trichloroethene, trans-1-,2-dichloroethene, acetone, tetrachloroethene, and trichloroethane. Based on available information, this site is considered to be of public health concern because of the risk from the exposure to hazardous substances via ingestion, dermal contact, and inhalation during the use of contaminated ground water. Known exposures have occurred in the past, however, community water has been provided to affected residences. Environmental pathways including atmospheric transport, storm water run off, and surface water contamination have not been assessed and therefore cannot be ruled out as sources of exposure.

47591 (PB–90-244187/XAB) **Health assessment for Oronogo-Duenweg Mining Belt, Jasper County, Missouri, Region 7. CERCLIS No. MDD980686281. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 29p. Source: NTIS, PC A03/MF A01.

The Oronogo-Duenweg Mining Belt site, Jasper County, Missouri, has been proposed by the U.S. Environmental Protection Agency (EPA) for inclusion on the National Priorities List (NPL). Referred to as the Missouri portion of the Tri-State (Missouri, Kansas, and Oklahoma) Mining District, the site comprises approximately 20 square miles and was the location of the most concentrated mining effort in the Tri-State District. As a result of commercial zinc and lead mining operations that occurred from about 1850 until the late 1960s, shallow groundwater, surface water, sediment, and surface soil are contaminated with heavy metals (zinc, lead, cadmium, and nickel). Municipalities in the area use both surface water and a deep aquifer for water supplies; individual households outside these centers rely on a shallow aquifer for water. Based upon information reviewed, the Agency for Toxic Substances and Disease Registry (ATSDR) has concluded that this site is of public health concern because of the risk to human health resulting from probable exposure to hazardous substances at concentrations that may result in adverse human health effects.

47592 (PB–90-244195/XAB) **Health assessment for Carrier Air Conditioning, Collierville, Shelby County, Tennessee, Region 4. CERCLIS No. TND044062222. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 1 Jun 1990. 12p. Source: NTIS, PC A03/MF A01.

The Carrier Air Conditioning site, an Update 7 site proposed for the National Priorities List, is located near Collierville in Shelby County, Tennessee. The site is currently the location of a manufacturing facility for air conditioners. Past waste disposal practices and spills have resulted in contamination of the underlying aquifer with trichloroethylene (TCE) and other volatile organic chemicals. TCE has been detected in two wells that supply the Collierville public water system. Water from these wells is being aerated to reduce TCE contamination to concentrations below the Federal drinking

water standard. No data were available to indicate whether site-related contaminants were present in private wells in the area or in the nearby Nonconnah Creek. There may be residual contamination in subsurface soils at the former lagoon and TCE spill areas. However, data are not available to determine whether these areas currently pose public health risks.

47593 (PB–90-244229/XAB) **Health assessment for Raymark Site, Hatboro, Montgomery County, Pennsylvania, Region 3. CERCLIS No. PAD039017694. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 18 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

The 7-acre Raymark site is an active manufacturing facility located in Hatboro, Montgomery County, Pennsylvania. The site, currently owned and operated by Penn Fasteners, Inc., was added to the Environmental Protection Agency's National Priorities List in October 1989. Penn Fasteners manufactures rivets and fasteners. Since about 1947, the facility has been operating under a number of owners. Wastes and waste water have been generated from plating and degreasing operations. Both the wastes and waste water were discharged into four lagoons constructed in the rear of the property. In the early 1970's, the lagoons were excavated and refilled with clean soil; however, soils and groundwater at the site are still heavily contaminated. The primary contaminants of concern at the Raymark site are trichloroethylene (TCE) and other chemical compounds that may form when TCE is chemically or physically broken down. Human exposure to the contaminated groundwater could occur via ingestion, inhalation of contaminants that may volatilize during domestic use (e.g., showering and cooking), and dermal absorption of contaminants. The Raymark site is considered to be of potential public health concern because humans may be exposed to hazardous substances in the groundwater and soil.

47594 (PB–90-244237/XAB) **Health assessment for Mosley Road Sanitary Landfill, Oklahoma City, Oklahoma County, Oklahoma, Region 6. CERCLIS No. OKD980620868. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 8 Jun 1990. 12p. Source: NTIS, PC A03/MF A01.

The Mosley Road Sanitary Landfill, an Update 7 site proposed for the National Priorities List, is located 3.3 miles east of Oklahoma City, Oklahoma County, Oklahoma. The 72-acre unlined landfill was operated as an above-ground sanitary landfill between the early 1970's and late 1976. In 1976, an estimated 1.4 million gallons of hazardous wastes were dumped into the landfill's two unlined on-site pits. In 1987, the landfill was closed. Analysis of samples collected before the landfill was closed revealed lead, methylene chloride, trichloroethene, and vinyl chloride in soil, groundwater, and surface water. Under current site conditions the major pathways for human exposure to site contaminants include the ingestion and other domestic uses of contaminated groundwater. Other potential pathways of human exposure to site contaminants include ingestion of and dermal contact with contaminated surface water and soil and inhalation of methane gas, which could be generated by decomposing landfill wastes. The site is determined to be of potential health concern based on the presence of groundwater contaminants and possible human exposure.

47595 (PB–90-244823/XAB) **Health assessment for Beulah Sanitary Landfill, Escambia, Florida, Region 4. CERCLIS No. FLD980494660. Preliminary report.** Florida State Dept. of Health and Rehabilitative Services, Tallahassee, FL (USA). 31 May 1990. 20p. Source: NTIS, PC A03/MF A01.

The Beulah Landfill proposed National Priorities List (NPL) site is located three miles west of Ensley, Escambia County, Florida. On-site contaminants at probable health concern levels are lead, thallium, chloroform, benzene, polychlorinated biphenyls (PCBs) and chlordane. Based on site conditions, the contaminants found on site could readily migrate off site via surface water or ground water. Off-site migration poses a threat to human exposure through ingestion and dermal absorption of contaminated surface water or animals that live in surface water, ground water, or soils. To a lesser extent, contaminants may also migrate off site in air, thereby posing a potential threat to human exposure via inhalation of windblown particles and volatilized contaminants. Based upon information reviewed, it is concluded that this site is of potential public health concern because of the risk to human health from possible exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Human Exposure Pathways section, human exposure to chlordane, thallium and PCBs could occur on site via incidental ingestion, inhalation and dermal absorption of the contaminated sludge.

47596 (PB–90-245283/XAB) **OASIS: A graphical decision-support system for ground-water contaminant modeling.** Newell, C.J.; Haasbeek, J.F.; Bedient, P.B. Groundwater Services, Inc., Houston, TX (USA). ©1990. 13p. Source: NTIS, PC A03/MF A01.

Pub. in Ground Water, Vol. 28, No. 2, 224-234(Mar-Apr 1990).

The decision support software described in the paper, the OASIS system, provides ground-water modelers with a ground-water biodegradation model, model documentation, background information, data from chemical and hydrogeologic databases, and data management tools. The system was developed using HyperCard software on a Macintosh personal computer. It currently has over 1700 different computer screens of information and occupies approximately 10 megabytes of hard disk storage. OASIS is a new type of modeling software where ground-water models, data, and knowledge are integrated together using a graphical interface and an easily modified software architecture. Two groups of users can benefit from the system: current modelers who need more efficient interfaces and data management tools, and people who are not using models now because the modeling process is too involved and requires special knowledge.

47597 (PB–90-245515/XAB) **Environmental factors influencing methanogenesis in a shallow anoxic aquifer: A field and laboratory study.** Beeman, R.E.; Suflita, J.M. Oklahoma Univ., Norman, OK (USA). Dept. of Botany and Microbiology. ©1990. 15p. Grant EPA-R-812808. Source: NTIS, PC A03/MF A01.

Pub. in Jnl. of Industrial Microbiology, Vol. 5, No. 1, 45-57(Jan 1990).

The environmental factors influencing methanogenesis in a shallow anoxic aquifer were probed in a combined field and laboratory study. Field data collected over a year revealed that in situ rates of methane production were depressed in winter and elevated in summer. Over the same period, ground water pH values ranged from 6.0 to 7.8 while temperatures varied from 7-22 C. In situ methanogenesis was severely inhibited at temperatures < 13 C or by pH values < 7. The influence of these factors on microbial methane formation from both endogenous and exogenous substrates were tested in aquifer slurries adjusted to pH 5-9 and incubated at temperatures ranging from 5-45 C. Temperature optima for methane production from endogenous substrates varied as a function of pH, but the pH optimum was 8 at all temperatures. Optimal conditions for acetoclastic methanogenesis were found at pH 8 and 35 C. An analysis of variance revealed that pH, temperature, and a pH-temperature interaction are all significant variables influencing aquifer methanogenesis. In addition transient sulfate accumulations were also found to limit methane production in some areas. A comparison of field and laboratory methane production patterns suggest that pH, temperature, and sulfate accumulations are important, but not the only environmental variables influencing the mineralization of organic matter in shallow aquifers.

47598 (PB–90-245812/XAB) **Relationship of catchment topography and soil hydraulic characteristics to lake alkalinity in the northeastern United States.** Wolock, D.M.; Hornberger, G.M.; Beven, K.J.; Campbell, W.G. Geological Survey, Trenton, NJ (USA). ©1989. 11p. Source: NTIS, PC A03/MF A01.

Pub. in Water Resources Research, Vol. 25, No. 5, 829-837(May 1989).

The authors undertook the task of determining whether base flow alkalinity of surface waters in the northeastern United States is related to indices of soil contact time and flow path partitioning that are derived from topographic and soils information. The influence of topography and soils on catchment hydrology has been incorporated previously in the variable source area model TOPMODEL as the relative frequency distribution of ln(a/Kb tan B), where ln is the Naperian logarithm, a is the area drained per unit contour, K is the saturated hydraulic conductivity, b is the soil depth, and tan B is the slope. Using digital elevation and soil survey data, the authors

calculated the ln (a/Kb tan B) distribution for 145 catchments. Indices of flow path partitioning and soil contact time were derived from the ln(a/Kb tan B) distributions and compared to measurements of alkalinity in lakes to which the catchments drain. They found that alkalinity was, in general, positively correlated with the index of soil contact time, whereas the correlation between alkalinity and the flow path partitioning index was weak at best. A portion of the correlation between the soil contact time index and alkalinity was attributable to covariation with soil base saturation and cation exchange capacity, while another portion was found to be independent of these factors. Although their results indicate that catchments with long soil contact time indices are most likely to produce high alkalinity base flow, a sensitivity analysis of TOPMODEL suggests that surface waters of these same watersheds may be susceptible to alkalinity depressions during storm events, due to the role of flow paths.

47599 (PB–90-246463/XAB) **TIME Project: A case study.** Pollack, A.K.; Ford, J. Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. 1990. 21p. (EPA–600/D-90/082). Source: NTIS, PC A03/MF A01.

The chapter describes the U.S. Environmental Protection Agency's (EPA's) monitoring project to assess the effects of changes in acidic deposition on surface waters of the United States. This project is referred to as TIME (Temporally Integrated Monitoring of Ecosystems). The TIME Project has been in the conceptual and design stage during the period 1987-1989. The planning period has allowed careful attention to many aspects of network design not usually covered prior to field implementation. The network design issues discussed in the paper are addressed within the context of the need for a policy-relevant, cost-effective national monitoring network to assess the effects of changes in atmospheric deposition of specific pollutants (sulfate and nitrate) on specific and well-defined target resources (U.S. surface waters of low acid-neutralizing capacity (ANC)).

47600 (PB–90-246513/XAB) **Direct/Delayed Response Project: Quality-assurance report for physical and chemical analyses of soils from the Southern Blue Ridge Province of the United States.** Van Remortel, R.D.; Byers, G.E.; Teberg, J.E.; Miah, M.J.; Papp, M.L. Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV (USA). Sep 1988. 276p. Source: NTIS, PC A13/MF A02.

See also PB–90-204710.

The Direct/Delayed Response Project is designed to address the concern over potential acidification of surface waters by atmospheric sulfur deposition within the United States. The Southern Blue Ridge Province Soil Survey was conducted during the summer of 1986 as a synoptic physical and chemical survey to characterize watersheds located in a region of the United States believed to be susceptible to the effects of acidic deposition. The document addresses the quality assurance program and its implementation in the assessment of the verified analytical data base for the Southern Blue Ridge Province Soil Survey. Data quality is assessed by describing the detectability, precision, accuracy (interlaboratory differences), representativeness, completeness, and comparability of the data for the quality assurance samples used throughout the soil survey. The fifty-one parameters in the data base are segregated into nine groups for ease in discussion.

47601 (PB–90-246547/XAB) **Health assessment for Linemaster Switch Corporation, Woodstock, Connecticut, Region 1. CERCLIS No. CTD001153923. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 25 Jun 1990. 14p. Source: NTIS, PC A03/MF A01.

The Linemaster Switch Corporation site has been proposed for the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA). The site is an active manufacturing facility, producing electrical and pneumatic foot switches and wiring harnesses. Painting wastes have been disposed of on site, resulting in volatile organic compound (VOC) contamination of ground water (primarily trichloroethylene or TCE). Private wells in the site vicinity have been impacted; alternate water supplies have been provided since 1986. Based on the available information, this site is considered to be of potential public health concern because of the risk to human health caused by the possibility of exposure to hazardous substances via contaminated ground water.

47602 (PB–90-246554/XAB) **Health assessment for Cheshire Associates Site, Cheshire, Connecticut, Region 1. CERCLIS No. CTD981067317. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 25 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

The Cheshire Associates site, Cheshire, Connecticut, has been proposed for the National Priorities List by the U.S. Environmental Protection Agency. Cheshire Associates leases the site to Airpax Corporation, which manufactures electrochemical and electronic devices. Groundwater and soil contamination by volatile organic compounds (VOCs) was documented before the Airpax lease was executed, and may have been caused by past disposal practices of the two manufacturers of plastic molding that occupied the site, Valley National Corporation and Cheshire Molding Company. Based upon information reviewed, the Agency for Toxic Substances and Disease Registry (ATSDR) has concluded that this site is of potential public health concern because of the risk to human health resulting from possible exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Human Exposure Pathways Section, human exposure to VOCs may occur via groundwater. ATSDR recommends additional environmental sampling to determine the extent of groundwater and soil contamination and to better identify any potentially affected population.

47603 (PB–90-246562/XAB) **Health assessment for Acme Solvents Reclamation, Inc., Winnebago County, Illinois, Region 5. CERCLIS No. ILD053219259 (amended). Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 12 Apr 1990. 17p. Source: NTIS, PC A03/MF A01.

See also PB–90-105941.

The Acme Solvents Reclamation, Inc. (Acme) National Priorities List (NPL) Site is located in Winnebago County, Illinois. The site is located in a semi-rural area characterized by low density housing. There are volatile organic compounds (VOCs), base neutral extractable compounds (BNECs), polychlorinated biphenyls (PCBs), and several metals present in the soil, sediment, groundwater, air, and/or leachate at or around the site. The Record of Decision (ROD) signed September 1985, mandated several remedial actions which included the provision of interim alternate water, excavation and incineration of waste and contaminated soil, landfilling of non-incinerable waste in an off-site Resource Conservation and Recovery Act (RCRA) landfill, and continued investigation of the connection between the groundwater flow and the bedrock.

47604 (PB–90-246570/XAB) **Health assessment for King of Prussia, Winslow Township, Camden County, New Jersey, Region 2. CERCLIS No. NJD980505341. Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 20 Jun 1990. 19p. Source: NTIS, PC A03/MF A01.

In compliance with the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act, as amended, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared Health Assessment reports for sites currently on, or proposed for, the National Priorities List (NPL). In the report, the presence and nature of health hazards at the site are assessed, and the public health implications specific to the site are evaluated. The Health Assessment is based on such factors as the nature, concentration, toxicity, and extent of contamination at the site; the existence of potential pathways for the human exposure; the size and nature of the community likely to be exposed; and any other information available to ATSDR that is relavant to a determination of potential risks to public health.

47605 (PB–90-246588/XAB) **Health assessment for Lodi Municipal Wellfield, Lodi, New Jersey, Region 2. CERCLIS No. NJD980769301. Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 20 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

The Lodi Municipal Wellfield consists of eleven municipal wells located in the Borough of Lodi, Bergen County, New Jersey. Significant levels of volatile organic compounds (VOC) have been detected in all the wells. In addition, analysis revealed one well site

with radiological contamination. Tap water obtained from two commercial businesses in Lodi, along with a private well, were also found with high levels of radionuclides. Consequently, these public wells which provided Lodi with its drinking water supply were individually closed down over a six year period. By June of 1987, all the municipal wells were permanently closed. The data clearly demonstrated the highly contaminated condition of this public water supply. Since these wells are now closed, they pose no immediate health concerns. But local residents and businesses who still rely on private wells for their drinking water supply may be at risk.

47606 (PB–90-246596/XAB) **Health assessment for Hopkins Farm, Plumsted Township, Ocean County, New Jersey, Region 2. CERCLIS No. NJD980532840. Final report.** New Jersey State Dept. of Health, Trenton, NJ (USA). 20 Jun 1990. 13p. Source: NTIS, PC A03/MF A01.

The Hopkins Farm site comprises a 4.5 acre area located in Plumsted Township, New Jersey. It is one of seven related hazardous waste sites (known collectively as the Plumsted Sites) allegedly utilized by the Thiokol Chemical Company during the 1960's. The remedial investigation commenced in February of 1987. Contaminants were identified in ground water, surface and subsurface soils. Major pathways of environmental concern and human exposure are those related to groundwater. The Hopkins Farm Site is considered to be a potential public health concern because humans may have been exposed to hazardous substances at concentrations that may result in adverse health effects. Inasmuch as there is no extant documentation or indication in the information reviewed for this Health Assessment that human exposure to contaminants at levels of public health concern is occurring, this site is not being considered for follow-up health studies at this time.

47607 (PB–90-246604/XAB) **Health assessment for Monitor Devices/Intercircuits, Inc., Wall Township, Monmouth County, New Jersey, Region 2. CERCLIS No. NJD980529406. Final report.** New Jersey State Dept. of Health, Trenton, NJ (USA). 20 Jun 1990. 15p. Source: NTIS, PC A03/MF A01.

Monitor Devices is an active site that was previously contaminated by discharges from a former electroplating operation. The soil and the groundwater at and near the site are contaminated with volatile organic compounds (VOCs), metals and PCBs (although it is not believed that the PCBs are related to the Monitor Devices operation). The small size of the site and the distance of the site from residential areas reduce the potential public health impact of the site. Fencing and posting, along with further exploration (identification, sampling, and/or modeling) of the industrial and potable wells, is recommended. Many of these activities are planned for in the remedial investigation that is underway. On the basis of the information reviewed, the Monitor Devices Site is a potential public health concern.

47608 (PB–90-246612/XAB) **Health assessment for Rockaway Township Wells, Rockaway Township, Morris County, New Jersey, Region 2. CERCLIS No. NJD980654214. Final report.** New Jersey State Dept. of Health, Trenton, NJ (USA). 20 Jun 1990. 11p. Source: NTIS, PC A03/MF A01.

The Rockaway Township Wells in Morris County, New Jersey have experienced contamination with volatile organic chemicals in the past. Because the wells served a population of approximately 12,500 persons, a potential threat to the public health existed. The addition of a treatment system in 1980 to remove volatile organics substantially reduced the exposure to the community. Continued and frequent monitoring of the raw and treated water from the wells must be maintained to ensure the efficacy of treatment. On the basis of the information reviewed, the Rockaway Township Well Site is a potential public health concern. Since human exposure to on-site/off-site contaminants has occurred in the past, the population of Rockaway Township served by the wells is being considered for inclusion in a large-scale epidemiologic study of the effects of drinking water contamination.

47609 (PB–90-247024/XAB) **Health assessment for Dover Municipal Well 4, Dover, New Jersey, Region 2. CERCLIS No. NJD980654131. Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 20 Jun 1990. 9p. Source: NTIS, PC A02/MF A01.

In compliance with the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act, as amended, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared Health Assessment reports for sites currently on, or proposed for, the National Priorities List. In the report, the presence and nature of health hazards at the site are assessed, and the public health implications specific to the site are evaluated. The Health Assessment is based on such factors as the nature, concentration, toxicity, and extent of contamination at the site; the existence of potential pathways for the human exposure; the size and nature of the community likely to be exposed; and any other information available to ATSDR that is relevant to a determination of potential risks to public health.

47610 (PB–90-247032/XAB) **Health assessment for Syntex Facility-Verona (Aka Syntex Agribusiness, Inc.), Verona, Lawrence County, Missouri, Region 7. CERCLIS No. MOD007452154 (amended). Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 8 Mar 1990. 35p. Source: NTIS, PC A03/MF A01.

See also PB–89-188734.

The U.S. Environmental Protection Agency (EPA) has requested a health consultation from the Agency for Toxic Substances and Disease Registry (ATSDR) concerning sampling data on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) levels in Spring River fish and sediments collected downstream of the Syntex Agribusiness facility (Syntex) in Verona, Missouri. These data were generated for the purpose of complying with a Consent Agreement and Order (the Order), signed by EPA and Syntex on September 6, 1983. The Order resulted in the Verona Plant Fish and Sediment Plan (the Plan), which was approved by the EPA on March 24, 1984. The Plan mandates yearly sampling for 5 years, beginning in 1984, and calls for an evaluation of the overall results after the 1988 sampling period so that recommendations about further sampling can be made. This Health Consultation has been prepared in response to EPA's request.

47611 (PB–90-247065/XAB) **Health assessment for Brick Township Landfill, Brick Township, Ocean County, New Jersey, Region 2. CERCLIS No. NJD980505176. Final report.** New Jersey State Dept. of Health, Trenton, NJ (USA). 20 Jun 1990. 14p. Source: NTIS, PC A03/MF A01.

In compliance with the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act, as amended, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared Health Assessment reports for sites currently on, or proposed for, the National Priorities List. In the report, the presence and nature of health hazards at the site are assessed, and the public health implications specific to the site are evaluated. The Health Assessment is based on such factors as the nature, concentration, toxicity, and extent of contamination at the site; the existence of potential pathways for the human exposure; the size and nature of the community likely to be exposed; and any other information available to ATSDR that is relevant to a determination of potential risks to public health.

47612 (PB–90-247073/XAB) **Health assessment for Wilson Farm, Plumsted Township, Ocean City, New Jersey, Region 2. CERCLIS No. NJD980532824. Final report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 20 Jun 1990. 14p. Source: NTIS, PC A03/MF A01.

The Wilson Farm site comprises a 10-acre area located in Plumsted Township, Ocean County, New Jersey. It is one of seven similar hazardous waste sites allegedly utilized by the Thiokol Chemical Company for the disposal of bulk liquid, solid, and drummed wastes during the 1960's. The Remedial Investigation commenced in February of 1987 to establish the nature and extent of on-site contamination. Contaminants were identified in ground and surface waters, soils, and sediment samples. The major pathways of concern are pathways related to soils, groundwater, and surface water. This site is considered by ATSDR and NJDOH to be of potential public health concern. Additional health study and/or evaluation is not indicated at this time.

47613 (PB–90-247081/XAB) **Health assessment for Price Landfill, Pleasantville, New Jersey, Region 2. CERCLIS No.**

NJD070281175. Final report. New Jersey State Dept. of Health, Trenton, NJ (USA). 20 Jun 1990. 16p. Source: NTIS, PC A03/MF A01.

In compliance with the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act, as amended, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared Health Assessment reports for sites currently on, or proposed for, the National Priorities List. In the report, the presence and nature of health hazards at the site are assessed, and the public health implications specific to the site are evaluated. The Health Assessment is based on such factors as the nature, concentration, toxicity, and extent of contamination at the site; the existence of potential pathways for the human exposure; the size and nature of the community likely to be exposed; and any other information available to ATSDR that is relevant to a determination of potential risks to public health.

47614 (PB–90-250408/XAB) **Health assessment for Hexcel Corporation Site, Livermore, Alameda County, California, Region 9. CERCLIS No. CAD058783952. Preliminary report.** Agency for Toxic Substances and Disease Registry, Atlanta, GA (USA). 9 Jul 1990. 15p. Source: NTIS, PC A03/MF A01.

Hexcel Corporation, located in Livermore, Alameda County, California, has been proposed to the National Priorities List (NPL) site. Two areas of concern exist at the site: the past organic chemical spills at the Hexcel facility, and the disposal of wastes by Hexcel and other corporations at a nearby abandoned disposal site, which was once owned by Hexcel. On the basis of information reviewed for the Preliminary Health Assessment, the site is of potential public health concern because humans may be exposured to hazardous substances at concentrations that may result in adverse health effects. Available information indicates that human exposure to various organic and inorganic compounds may be occurring or may have occurred via ingestion of, dermal contact with, or inhalation of contaminants in ground water. Additional off-site ground water monitoring and a well use survey are needed to evaluate the potential for the exposure.

47615 (PNL–7170) **Results from Nevada Nuclear Waste Storage Investigations (NNWSI) Series 3 spent fuel dissolution tests.** Wilson, C.N. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 160p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE90016665. Source: NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

The dissolution and radionuclide release behavior of spent fuel in groundwater is being studied by the Yucca Mountain Project (YMP), formerly the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. Specimens prepared from pressurized water reactor fuel rod segments were tested in sealed stainless steel vessels in Nevada Test Site J-13 well water at 85°C and 25°C. The test matrix included three specimens of bare-fuel particles plus cladding hulls, two fuel rod segments with artificially defected cladding and water-tight end fittings, and an undefected fuel rod section with watertight end fittings. Periodic solution samples were taken during test cycles with the sample volumes replenished with fresh J-13 water. Test cycles were periodically terminated and the specimens restarted in fresh J-13 water. The specimens were run for three cycles for a total test duration of 15 months. 22 refs., 32 figs., 26 tabs.

47616 (PNL-SA–18118) **Experimental simulation of transient three-phase flow in porous media.** Graham, D.N. (SIMULTEC Ltd., Meilen/Zurich (Switzerland)); Schiegg, H.O.; McBride, J.F. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900476–2: IAH conference on subsurface contamination by immiscible fluids, Calgary (Canada), 18-20 Apr 1990). Order Number DE90016331. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experimental data are required to verify and calibrate numerical, multiphase flow models. This paper summarizes several two-dimensional, transient, three-phase flow experiments using air, water, and a light immiscible liquid (LIL). The LIL infiltration and redistribution experiments were performed in a glass-sided flume, filled with a uniform quartz sand. Initial water saturation distributions above the water table were either at drainage or imbibition equilibrium. After the LIL reached a near equilibrium distribution, it was redistributed by raising and lowering the water table. Saturations of the air, water and oil were measured by using dual gamma-ray attenuation. Simultaneously, the pressures of the water and oil phases were measured by using hydrophobic and hydrophilic porous cups imbedded in the sand and connected to pressure transducers. In one experiment, multiple pulses of LIL were added over several days. As expected, the first pulse was observed to infiltrate and redistribute more slowly in pristine zones than subsequent pulses into zones containing residual oil. The observed distributions of the three fluid saturations are discussed with respect to two- and three-phase capillary pressure-saturation relationships that were measured in a one-dimensional vertical column. 14 refs., 6 figs.

47617 (PNL-SA–18352) **Automatic adjustment of crop coefficients for projecting water balance.** Campbell, M.D.; Berrett, M.K. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 13p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9006262–1: American association for the advancement of science symposium agricultural water conservation and quality, Davis, CA (USA), 19-23 Jun 1990). Order Number DE90016564. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An accurate projection of evapotranspiration (ET) depends on a correct crop coefficient (k_c) and a reliable model of potential evapotranspiration (PET). Water balance was used to correct k_c and PET. Modeled PET should agree with its reference standard within 10% for 1 day and should converge on the long-term average within 2 weeks, even when weather variables are extreme. The product of k_c x PET should have similar characteristics if long-term water balance projections depend on it. Where water distribution may require advance scheduling of 2 to 5 days, errors resulting from wrong crop coefficients may seriously reduce efficiency. Because it is common to find k_c values in error by 50% or more, particularly during early stages of plant growth, actual water use was measured periodically to adjust the k_c values. Adjustments of the two ends of the crop curve accounted for different levels of plant activity and stages of growth. We adjusted the magnitude of the k_c values by comparing calculated with measured water use, based on neutron probe measurements. Modeled ET thus estimates measured water balance closely. The significance of this work is that refinements in crop coefficients improved water and nutrient use efficiency on irrigated crops and reduced loss to groundwater. 7 refs., 2 figs.

47618 (UCRL-ID–104342) **Site inspection of the disposal site near Building 823, Lawrence Livermore National Laboratory Site 300.** Environmental Restoration Series. Crow, N.B. (Lawrence Livermore National Lab., CA (USA)); Carpenter, D.W.; Toney, K.C. Lawrence Livermore National Lab., CA (USA). Jul 1990. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016653. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents the results of a site inspection performed at a disposal site located approximately 150 ft southwest of Building 823 at Lawrence Livermore National Laboratory (LLNL) Site 300. LLNL is operated for the US Department of Energy by the University of California. The major programs at LLNL have been devoted to the design and testing of nuclear weapons and to magnetic fusion research. Since 1952, LLNL has added other major programs, including applied laser fusion research, laser isotope separation, biomedical and environmental studies, and applied energy technologies. Operations at Site 300 began in 1955. Major programmatic operations at Site 300 include hydrodynamic testing of non-nuclear explosive assemblies, including diagnostic tests; physical, environmental, and dynamic tests; and high explosives (HE) formulation and fabrication. In addition, particle beam research has been conducted at Site 300. Topics include stratigraphy, structure, hydrogeology, and analytical results. 11 refs., 3 figs., 3 tabs.

47619 Geohydrologic data for test well USW H-6 Yucca Mountain area, Nye County, Nevada. USGS Open-File report 83-856. Craig, R.W.; Reed, R.L.; Spengler, R.W. 35p. Geological Survey, Denver, CO (US) (1983).

The following data are presented for test well USW H-6: drilling operations, lithology, availability of borehole geophysical logs, water levels, future availability of core analyses, water chemistry, pumping tests, and packer-injection tests. The well is one of a series of test wells drilled in and near Yucca Mountain adjacent to the Nevada Test Site, Nye County, Nevada, in cooperation with the US Department of Energy. These investigations are part of the Nevada Nuclear Waste Storage Investigations to identify suitable sites for underground storage of high-level radioactive wastes. Test well USW H-6 was drilled to a total depth of 1,220 m. Rocks penetrated are predominantly ash-flow tuffs. Lava was encountered from 877 to 1,126 m. The composite static water level is approximately 526 m below land surface. The well was pumped during two periods. Maximum drawdown was about 18 m after pumping for 4,822 min at 28 L/sec, and 12 m after pumping for 2,226 min at 27 L/sec. A borehole flow survey showed that 91% of the water withdrawn from the well came from the depth intervals from 616 to 631 m, and from 777 to 788 m. 8 refs., 18 figs., 6 tabs.

47620 **Formaldehyde in drinking water: Comparative hazard evaluation and an approach to regulation.** Owen, B.A. (Oak Ridge National Laboratory, TN (USA)); Dudney, C.S.; Tan, E.L.; Easterly, C.E. *Regulatory Toxicology and Pharmacology (USA)*, 11(3): 220-236 (Jun 1990).

Formaldehyde, a widely used industrial chemical to which humans are ubiquitously exposed, presented cause for concern when it was demonstrated to be carcinogenic in laboratory animals. Risk assessment protocols subsequently applied to formaldehyde are of questionable validity in light of the results of recent mechanistic investigations of biological responses to formaldehyde. Further, the hazard of ingested formaldehyde is not addressed in current assessment protocols. This paper addresses the potential human health risks accompanying low-level exposure to formaldehyde as a contaminant in drinking water. In this exposure scenario, noncarcinogenic risk from inhalation of formaldehyde from drinking water is evaluated through knowledge of the metabolism and biological effects of formaldehyde exposure. Noncarcinogenic risk from ingestion of formaldehyde in drinking water is evaluated from the perspective gained by comparison with dietary sources of formaldehyde. Carcinogenic risk to humans is evaluated in light of recent investigations into the mechanisms underlying biological responses to formaldehyde exposure. Finally, based on a comparison of ingestion of formaldehyde in drinking water with ingestion of naturally occurring formaldehyde in foods, a comparative hazard approach to formaldehyde regulation is offered as a supplement to the rigid evaluation protocols currently used. 54 references.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 47261

5501 Behavioral Biology

47621 (DOE/ER/60633–T1) **Mass and energy budgets of animals: Behavioral and ecological implications: Progress report, July 1, 1988–July 1, 1990.** Porter, W.P. Wisconsin Univ., Madison, WI (USA). Aug 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER60633. Order Number DE90016298. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are now beginning a long term exploration of environmental constraints on continent-wide growth and reproduction in ectotherms and endotherms. We have begun to study a new lizard species, Cnemidophorus sexlineatus, an active forager with a wide geographic distribution. Our state-of-the-art vacuum gas analysis system continues to function well, and we are using doubly labeled wear routinely in our research to test our first principle calculations of field metabolism and water loss. The computer controlled respirometer system routinely measures respiratory gases and body temperatures in small living mammals. We have just added two more species of mammals, Gerbillus allenbyi and Gerbillus pyramidum from Israel, to the list of 9 species of mammals and two species of birds for which we have successfully tested the dry fur model. We use gas respirometry in the laboratory and doubly labeled water in the field to verify the calculations of our models. We continue to focus on the dynamics of interactions between environmental and animal variance and their implications for growth and reproduction and the links between environmental effects on organisms and population dynamics. 9 refs., 14 figs.

47622 **Maintaining momentum: The process of self-motivation.** Kloepfer, M. (ACTION-Housing, Inc., Pittsburgh, PA (USA)). pp. 73 of Affordable comfort III program. Action-Housing, Inc., Pittsburgh, PA (US) (1988). (CONF-8811288–: 3. affordable comfort, Pittsburgh, PA (USA), 29 Nov - 1 dec 1988).

This tutorial explores motivation as an ongoing, internalized process. Experiential and reflective by design, it focuses on the self-talk methods which energy professionals use to energize themselves, manage stress, and prevent burn-out. The basic issue to be addressed is how to meet long-term job demands and responsibilities. Motivated by conference experiences, participants create an individual plan in response to the question: What will I do differently as a result of attending this conference? As a result of this tutorial, participants will: (1) Participate in reflective conversation about Affordable Comfort Conference experiences, using the data to set priorities for individual planning; (2) Be given solitary reflection time to complete the assignment: As a result of this conference I need to ...; (3) Discuss and experience self-talk methods/principles of stress management and burn-out prevention, using the book, Freedom from Stress: A Holistic Approach, by Phil Nuernberger, PhD.

5502 Biochemistry

Refer also to citation(s) 46773, 46774

47623 (BNL–43799) **SV40 large tumor antigen and the tumor suppressor p53 are phosphorylated by a DNA-activated protein kinase from human cells.** Lees-Miller, S.P.; Chen, Yuh-Ru; Anderson, C.W. Brookhaven National Lab., Upton, NY (USA). [1990]. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (BIO–4569;CONF-9007160–1: 8. international conference on methods in protein sequence analysis, Kiruna (Sweden), 1-7 Jul 1990). Order Number DE90016556. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Short communication. ANTIGENS/phosphorylation; PHOSPHOPROTEINS/phosphorylation; PHOSPHOTRANSFERASES/biological functions; NEOPLASMS; ANTIGENS; PHOSPHORYLATION; PHOSPHOPROTEINS; PHOSPHOTRANSFERASES; ANIMAL CELLS; GROWTH; CELL DIFFERENTIATION; ONCOGENES; INHIBITION; IN VITRO; GENE REGULATION; DNA; PROTEIN STRUCTURE; AMINO ACIDS

47624 (LA-UR–90-2733) **Relationship of cytochrome caa_3 from Thermus thermophilus to other heme- and copper-containing terminal oxidases.** Mather, M.W.; Springer, P.; Fee, J.A. Los Alamos National Lab., NM (USA). [1990]. 26p. Sponsored by U.S. DOE Office of Administration and Human Resource Management; U.S. Department of Health and Human Services. DOE Contract W-7405-ENG-36. Grant GM35342. (CONF-9004239–1: 41. Mosbach colloquium, Heidelberg (Germany, F.R.), 4-8 Apr 1990). Order Number DE90016512. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Cytochrome oxidases are a key component of the energy metabolism of most aerobic organisms from mammals to bacteria. They are the final enzyme of the membrane associated respiratory chain responsible for converting the chemical energy of reduced substrates to a transmembrane electrochemical potential, which is-sused by the cell for a wide variety of energy-requiring processes. The most widely studied oxidase is the cytochrome c oxidase of the mammalian mitochondrion. This complex, integral membrane protein contains 13 subunits and four canonical metal centers: heme center a and a_3; copper centers CU_A and CU_B. It is responsible for electron transfer from reduced chytochrome c to dioxygen with the concomitant reduction of dioxygen to water and the coupled vectorial transfer of protons across the mitochondrial membrane. In this communication we will describe preliminary results of DNA sequencing experiments with the cytochrome caa_3 oxidase, initially undertaken to determine the nature of the subunits of this

oxidase and shed light on the distribution of the metal centers. We will speculate on oxidase gene and protein structures and evolutionary relationships in the light of these results and recent sequencing results from other groups. 47 refs., 4 figs., 1 tab.

47625 The growth response in deepwater rice: Biophysical and ultrastructural investigations. Kende, H. (Michigan State Univ., East Lansing (USA)); Kutshera, U. *Plant Physiology, Supplement (USA),* 89(4): 42 (Apr 1989).

Partial submergence induces rapid internodal elongation in deepwater rice. This response is mediated by ethylene and gibberellin and is based, in part, on enhanced cell elongation. Rapidly growing internodes exhibit increased plastic extensibility of the cell walls and tissue tension. The latter indicates that the outer epidermis is growth limiting. The ultrastructure of the cell wall/plasmalemma interface was investigated in the region where cell elongation takes place. In submerged internodes, electron-dense particles of about 100 nm diameter were found at the outer epidermal cell wall but not at the inner epidermal wall at the inner epidermal walls or the walls of interior cells. They were also not detected at the outer epidermal walls of air-grown internodes. We suggest that these particles are related to growth of the outer epidermis.

47626 Aggregation states of phosphoribulokinase (PRK) in vivo. Porter, M.A. (Oak Ridge National Lab, TN (USA)); Hartman, F.C. *Plant Physiology, Supplement (USA),* 89(4): 50 (Apr 1989).

Spinach PRK, extracted from either light- or dark-harvested tissue (LHT or DHT) in the presence of DTT, has a M_r of 90 kDa and is fully active. Consistent with an earlier study extraction of LHT in the absence of DTT results in two forms of inactive PRK, M_r 90 kDa (LMW) and $M_r >$ 550 kDa (HMW). If 400 mM $(NH_4)_2SO_4$ without DTT is included during extraction, the active LMW predominates implicating it as the major, functional form in vivo during periods of illumination. Either high- or low-sale extraction of DHT reveals mostly HMW; prolonged incubation of the high-salt extract causes disaggregation of LMW without activation. These data suggest that the dark form of PRK in vivo is an aggregate, formed by either self-association or by interactions with other proteins. Salt-induced disaggregation of HMW is inconsistent with intermolecular disulfides crosslinking the aggregated PRK; therefore, oxidation-induced conformational changes must promote aggregation.

47627 Distribution of δ-aminolevulinic acid biosynthetic pathways among phototrophic and related bacteria. Avissar, Y.J. (Brown Univ., Providence, RI (USA)); Beale, S.I.; Ormerod, J.G. *Plant Physiology, Supplement (USA),* 89(4): 51 (Apr 1989).

Two biosynthetic pathways are known for the universal tetrapyrrole precursor, δ-aminolevulinic acid (ALA): condensation of glycine and succinyl-CoA to form ALA with the loss of C-1 of glycine as CO_2, and conversion of the intact carbon skeleton of glutamate to ALA in a process requiring $tRNA^{Glu}$, ATP, Mg^{2+}, NADPH, and pyridoxal phosphate. The distribution of the two ALA biosynthetic pathways among various bacterial genera was determined, using cell-free extracts obtained from representative organisms. Evidence for the operation of the glutamate pathway was obtained by the measurement of RNase-sensitive label incorporation from glutamate into ALA using 3,4-[^{3}H]glutamate and 1-[^{14}C]glutamate as substrate. The glycine pathway was indicated by RNase-insensitive incorporation of level from 2-[^{14}C]glycine into ALA. The distribution of the two pathways among the bacteria tested was in general agreement with their previously phylogenetic relationships and clearly indicates that the glutamate pathway is the more ancient process, whereas the glycine pathway probably evolved much later. The glutamate pathway is the more widely utilized one among bacteria, while the glycine pathway is apparently limited to the α subgroup of purple bacteria (including Rhodobacter, Rhodospirillum, and Rhizobium). E. coli was found ALA via the glutamate pathway. The ALA-requiring hemA mutant of E. coli was determined to lack the dehydrogenase activity that utilizes glutamyl-tRNA as a substrate.

47628 Separation of the enzymes required for transformation of glutamate to δ-aminolevulinic acid in extracts of Synechocystis sp. PCC 6803. Rieble, S. (Brown Univ., Providence, RI (USA)); Beale, S.I. *Plant Physiology, Supplement (USA),* 89(4): 51 (Apr 1989).

In higher plants, algae, and a wide variety of prokaryotes, the tetrapyrrole pigment precursor δ-aminolevulinic acid (ALA) is formed from glutamate by a process requiring at least three enzymatic components plus $tRNA^{Glu}$, ATP, NADPH, M^{2+}, and pyridoxal phosphate. Previous reports have shown that the cyanobacterium Synechocystis sp. PCC 6803 produces ALA via the glutamate pathway. We report here the separation of this activity into three enzymatic fractions. Cells were harvested and broken in a French pressure cell. Protein precipitating between 30-55% $(NH_4)_2SO_4$ saturation were separated on Blue-Sepharose into unbound protein (fraction I) and bound protein which was further separated on 2′-5′ ADP-agarose into unbound protein (fraction II) and bound protein (fraction III). Reconstitution of ALA-forming activity protein (fraction II) and bound (fraction III). Reconstitution of ALA-forming activity required all three fractions. Only fraction II had the ability to aminoacylate tRNA with glutamate in the presence of ATP and Mg^{2+} and therefore contains the glutamyl-tRNA synthetase. After reisolation by phenol extraction, the glutamyl-tRNA could be used as substrate for ALA formation in incubations containing fractions I and III. Only fraction I had the ability to convert synthetic glutamate-1-semialdehyde into ALA. This enzyme activity was 90% inhibited by 5μM gabaculine. The mol wts of the activities in fraction I and II were estimated by Sephadex G-150 gel filtration to be 99,000 and 63,000 (+ 5,000), respectively. The results indicate that the protein components of the ALA-forming pathway in Synechocystis are similar to those of higher plants and eukaryotic algae.

47629 Purification of extrachloroplastic β-amylase from leaves of starchless and wild type Arabidopsis. Somerville, C. (Michigan Sate Univ., East Lansing (USA)); Monroe, J.; Preiss, J. *Plant Physiology, Supplement (USA),* 89(4): 80 (Apr 1989).

Amylase activity in crude leaf extracts from starchless mutants of Arabidopsis thaliana is 5 to 10 fold higher than in the wild type (WT) when plants are grown under a 12 h photoperiod. Visualized on native PAGE, the increased activity is attributed primarily to a previously characterized extrachloroplastic β-(exo)amylase. The β-amylases from phosoglucomutase deficient (starchless) and WT leaves were purified to homogeneity in two steps utilizing polyethylene glycol fractionation, and cyclohexaamylose affinity chromatography. The enzyme from both mutant and WT leaves had negligible activity toward either β-limit dextrin or pullulan. The specific activities of both purified enzymes were similar indicating that the protein is over-expressed in the mutant. Preliminary antibody neutralization experiments suggest that the two β-amylases are not different.

47630 Alternative oxidase expression in aged potato tuber slices. Hiser, C. (Michigan State Univ., East Lansing (USA)); Herdies, L.; McIntosh, L. *Plant Physiology, Supplement (USA),* 89(4): 87 (Apr 1989).

Higher plant mitochondria posses a cyanide-resistant, hydroxamate-sensitive alternative pathway of electron transport that does not conserve energy. Aging of potato tuber slices for 24 hours leads to the development of an alternative pathway capacity. We have shown that a monoclonal antibody raised against the alternative pathway terminal oxidase of Sauromatum guttatum crossreacts with a protein of similar size in aged potato slice mitochondria. This protein was partially purified and characterized by two-dimensional gel electrophoresis, and its relative levels parallel the rise in cyanide-resistant respiration. We are using a putative clone of the S. guttatum alternative oxidase gene to isolate the equivalent gene from potato and to examine its expression.

47631 Isolation of putative cDNA clones of the alternative oxidase of Sauromatum guttatum. Rhoads, D.M. (Michigan State Univ., East Lansing (USA)); McIntosh, L. *Plant Physiology, Supplement (USA),* 89(4): 87 (Apr 1989).

Antigenically related protein of 35, 36, and 37 kDa are involved in the alternative respiratory pathway in the appendix of S. guttatum. Polyclonal antibodies specific to these proteins immunoprecipitated a 42 kDa putative precursor from total in vitro translated products. Monoclonal and polyclonal antibodies were used to identify clones from a S. gluttatum cDNA expression library. These clones were capable of hybrid-selecting polyA+ RNA

transcripts which, when translated in vitro, produced a 42 kDa protein that can be immunoprecipitated by the polyclonal antibodies. These data suggest that the cDNA clones encode one or more of the alternative oxidase proteins of S. guttatum. The clones will be used to investigate the developmental expression of the alternative oxidase proteins in S. guttatum.

47632 Exogenous proline relieves growth inhibition caused by NaCl in petunia cells: Metabolism of L-[^{15}M]-proline followed by ^{15}N NMR. Heyser, J.W. (Los Alamos National Lab., NM (USA)); Chacon, M.J. *Plant Physiology, Supplement (USA),* 89(4): 90 (Apr 1989).

Exogenous proline stimulated the growth of Petunia hybrida cells on 195 mM NaCl 10-fold as compared with cells grown on 195 mM CaCl medium minus proline. L-[^{15}N]-proline was fed to cells growing on 0 and 195 mM CaCl, and its metabolism was followed by ^{15}N NMR analysis of cell extracts. Total proline and amino acids were determined by ninhydrin assay. Proline and primary amino acids were easily resolved in NMR spectra and the amount of ^{15}N-label which remained in proline was determined. Reduced catabolism of proline in cells grown on NaCl was evident. The role of exogenous proline in conferring increased NaCl tolerance in this nonhalophyte will be discussed.

47633 Purification of gibberellin$_{53}$-oxidase from spinach. Wilson, T.M. (Michigan State Univ., East Lansing (USA)); Zeevaart, J.A.D. *Plant Physiology, Supplement (USA),* 89(4): 106 (Apr 1989).

Spinach is a long-day rosette plants, in which stem growth is mediated by gibberellins. It has been shown that two enzymatic steps, GA_{53}-oxidase and GA_{19}-oxidase, are controlled by light. To develop an understanding into this light regulation, purification of GA_{53}-oxidase has been undertaken. The original assay relied on the HPLC separation of the product and substrate, but was considered too slow for the development of a purification scheme. A TLC system was developed which in conjunction with improvements to the assay conditions was sensitive and gave rapid results. The partial purification of the GA_{53}-oxidase is achieved by a high speed centrifugation, 40-55% ammonium sulfate precipitation, an hydroxyapatite column, Sephadex G-100 column and an anion exchange FPLC column, Mono Q HR10/10, yielding 1000-fold purification and 15% recovery. Monoclonal antibodies to the protein will be raised and used to further characterize the enzyme.

47634 Endogenous gibberellins and stem growth as related to photoperiod in Silene armeria L. Talon, M. (Michigan State Univ., East Lansing (USA)); Zeevaart, J.A.D. *Plant Physiology, Supplement (USA),* 89(4): 106 (Apr 1989).

The early 13-hydroxylation gibberellin (GA) pathway operates in the long-day plant Silene armeria grown under both long-day (LD) and short-day (SD) conditions. Thus, induction of stem growth must be related to quantitative changes in GA pattern. Using GC-SIM-MS and GAs labeled with stable isotopes as internal standards, the levels of GA_{53}, GA_{19}, GA_{20}, and GA_1 were measured in shoots and various organs of plants grown under different photoperiods. Exposure to 8 LD decreased the levels of GA_{53} and GA_{19}, and increased the levels of GA_{20} and particularly of GA_1; the latter GA accumulated to very high levels in expanding leaves and tips. When plants were exposed to LD, followed by SD, GA levels decreased, and the relative increases in stem length were correlated with the level of GA_1 at the time the plants were returned to SD. These observations suggest that GA_{53}-oxidase, and probable also GA_{19}-oxidase, are under photoperiodic control. Furthermore, GA_1 appears to be active per se in Silene in causing stem growth, since its level was always correlated with the degree of stem elongation.

47635 ARA-aldehyde and ABA-trans-diol in apple fruits. Rock, C.D. (Michigan State Univ., East Lansing (USA)); Zeevaart, J.A.D. *Plant Physiology, Supplement (USA),* 89(4): 113 (Apr 1989).

We have isolated ABA-aldehyde and ABA-t-diol from postharvest apple fruits, cv. Granny Smith and confirmed their structure by GC-MS. These putative ABA biosynthetic precursors incorporate ^{18}O to a similar degree as ABA during 48 hours under $^{18}O_2$ atmospheres. The presence of significant amounts of ABA-aldehyde can explain the unique ^{18}O labeling pattern of ABA in this tissue, where a majority of ABA molecules containing ^{18}O is labeled in the 1′-hydroxyl group and not in the side chain carboxyl group, the primary site of incorporation for stressed leaves. Exchange of the carbonyl oxygen of ABA-aldehyde with water would decrease ^{18}O enrichment in the side chain. Results of $^{18}O_2$ experiments and feeding studies using hexadeutero-ABA-aldehyde will be presented and the biosynthetic relationship of these compounds discussed.

47636 Small-scale field test of the genetically engineered lacZY marker. Hattemer-Frey, H.A. (Oak Ridge National Laboratory, TN (USA)); Brandt, E.J.; Travis, C.C. *Regulatory Toxicology and Pharmacology (USA),* 11(3): 253-261 (Jun 1990).

Commercial genetic engineering is advancing into areas that require the small-scale introduction of genetically engineered microorganisms (GEMs) to better quantify variables that affect microorganism distribution and survival and to document potential long-term consequences. A recombinant DNA marker system, the lacZY marker, developed by the Monsanto Agricultural Co., enables the distribution and fate of marked fluorescent pseudomonad organisms to be monitored under actual field conditions. Critical evaluation of GEMs under field conditions is imperative if plant-beneficial effects are to be correlated with organism release. This paper evaluates the effectiveness of this marker system and its ability to facilitate the assessment of risks associated with deliberate environmental introductions of genetically engineered microorganisms. Results of prerelease contained growth chamber and field experiments demonstrated that: (1) the scientific risk assessment methodology adopted by Monsanto and approved by the U.S. Environmental Protection Agency was appropriate and comprehensive; (2) the deliberate introduction of a GEM did not pose unacceptable or unforeseen risks to human health or the environment; (3) the lacZY marker is an effective environmental tracking tool; and (4) regulatory oversight should reflect the expected risk and not be excessively burdensome for all GEMs.

47637 Mild water stress of Phaseolus vulgaris plants leads to reduced starch synthesis and extractable sucrose phosphate synthase activity. Vassey, T.L. (Univ. of Wisconsin, Madison (USA)); Sharkey, T.D. *Plant Physiology (USA),* 89(4): 1066-1070 (Apr 1989).

Mild water stress, on the order of −1.0 megapascals xylem water potential, can reduce the rate of photosynthesis and eliminate the inhibition of photosynthesis caused by O_2 in water-stress-sensitive plants such as Phaseolus vulgaris. To investigate the lack of O_2 inhibition of photosynthesis, we measured stromal and cytosolic fructose-1,6-bisphosphatase, sucrose phosphate synthase, and partitioning of newly fixed carbon between starch and sucrose before, during, and after mild water stress. The extractable activity of the fructose bisphosphatases was unaffected by mild water stress. The extractable activity of SPS was inhibited by more than 60% in plants stressed to water potentials of −0.9 megapascals. Water stress caused a decline in the starch/sucrose partitioning ratio indicating that starch synthesis was inhibited more than sucrose synthesis. We conclude that the reduced rate of photosynthesis during water stress is caused by stomatal closure, and that the restriction of CO_2 supply caused by stomatal closure leads to a reduction in the capacity for both starch and sucrose synthesis. This causes the reduced O_2 inhibition and abrupt CO_2 saturation of photosynthesis.

47638 Electrophoretic assay for ribulose 1,5-bisphosphate carboxylase/oxygenase in guard cells and other leaf cells of Vicia faba L. Tarczynski, M.C. (Florida State Univ., Tallahassee (USA)); Outlaw, W.H. Jr.; Arold, N.; Neuhoff, V.; Hampp, R. *Plant Physiology (USA),* 89(4): 1088-1093 (Apr 1989).

The ribulose 1,5-bisphosphate carboxylase/oxygenase (Rubisco) contents of guard cells and other cells of Vicia faba L. leaflet were determined. To prevent proteolysis, proteins of frozen protoplast preparations or of cells excised from freeze-dried leaf were extracted directly in a sodium-dodecyl-sulfate-containing solution which was heated immediately after sample addition. Protein profiles of the different cell types were obtained by electrophoresis of the extracts and subsequent densitometry of the stained protein bands. About one-third of the protein of palisade parenchyma and

of spongy parenchyma was Rubisco large subunit. Using chlorophyll (Chl):protein ratios previously obtained, we calculate mesophyll contained ca. 22 millimoles Rubisco per mole Chl. In contrast, guard-cell protoplast preparations were calculated to contain from 0.7 to 2.2 millimoles Rubisco per mole Chl. The upper end of this range is an overestimate resulting from contamination by mesophyll and to the method of peak integration. Extracts of excised guard cells were calculated to contain 0.05 to 0.17 millimole Rubisco per mole Chl. We conclude that Rubisco is absent, or virtually so, in guard cells of V. faba.

47639 Cross-reactive and specific monoclonal antibodies against cellobiohydrolases I and II and endoglucanases I and II of trichoderma reesei. Nieves, R.A. (Colorado State Univ., Fort Collins (USA)); Todd, R.J.; Ellis, R.P.; Himmel, M.E. *Applied and Environmental Microbiology (USA),* 56(4): 1103-1108 (Apr 1990).

Splenocytes derived from mice inoculated with a commercial cellulase preparation or purified cellulases were fused with a stable myeloma cell line (SP2/0). Specific monoclonal antibodies to cellobiohydrolases I and II and endoglucanases I and II were established. In addition to specific monoclonal antibodies, we were also able to establish stable hybridoma cell lines which produced monoclonal antibodies that recognized similar epitopes possessed by two or more of the above cellulases. By obtaining monospecific antibodies for all four individual cellulases, the role and function of the individual cellulases can thus be studied in greater detail.

47640 Monoclonal antibodies to the alternative oxidase of higher plant mitochondria. Elthon, T.E. (Michigan State Univ., East Lansing (USA)); Nickels, R.L.; McIntosh, L. *Plant Physiology (USA),* 89(4): 1311-1317 (Apr 1989). DOE Contract AC02-76ER01338.

The higher plant mitochondrial electron transport chain contains, in addition to the cytochrome chain which terminates with cytochrome oxidase, an alternative pathway that terminates with an alternative oxidase. The alternative oxidase of Sauromatum guttatum Schott has recently been identified as a cluster of proteins with apparent M_r of 37, 36, and 35 kilodaltons (kD). Monoclonal antibodies have now been prepared to these proteins and designated as AOA (binding all three proteins of the alternative oxidase cluster), AOU (binding the upper or 37 kD protein), and AOL (binding the lower or 36 and 35 kD proteins). All three antibodies bind to their respective alternative oxidase proteins whether the proteins are in their native or denatured states. AOA and AOU inhibit alternative oxidase activity around 49%, whereas AOL inhibits activity only 14%. When coupled individually to Sepharose 4B, all three monoclonal resins were capable of retaining the entire cluster of alternative oxidase proteins, suggesting that these proteins are physically associated in some manner. The monoclonals were capable of binding similar mitochondrial proteins in a number of thermogenic and nonthermogenic species, indicating that they will be useful in characterizing and purifying the alternative oxidase of different systems. The ability of the monoclonal-Sepharose 4B resins to retain the cluster of previously identified alternative oxidase proteins, along with the inhibition of alternative oxidase activity by these monoclonals, supports the role of these proteins in constituting the alternative oxidase.

47641 Biochemical and histochemical localization of monoterpene biosynthesis in the glandular trichomes of spearmint (Mentha spicata). Gershenzon, J. (Washington State Univ., Pullman (USA)); Maffei, M.; Croteau, R. *Plant Physiology (USA),* 89(4): 1351-1357 (Apr 1989). DOE Contract FG06-88ER13869.

The primary monoterpene accumulated in the glandular trichomes of spearmint (Mentha spicata) is the ketone (-)-carvone which is formed by cyclization of the C_{10} isoprenoid intermediate geranyl pyrophosphate to the olefin (-)-limonene, hydroxylation to (-)-trans-carveol and subsequent dehydrogenation. Selective extraction of the contents of the glandular trichomes indicated that essentially all of the cyclase and hydroxylase activities resided in these structures, whereas only about 30% of the carveol dehydrogenase was located here with the remainder located in the rest of the leaf. This distribution of carveol dehydrogenase activity was confirmed by histochemical methods. Electrophoretic analysis of the partially purified carveol dehydrogenase from extracts of both the glands and the leaves following gland removal indicated the presence of a unique carveol dehydrogenase species in the glandular trichomes, suggesting that the other dehydrogenase found throughout the leaf probably utilizes carveol only as an adventitious substrate. These results demonstrate that carvone biosynthesis takes place exclusively in the glandular trichomes in which this natural product accumulates.

47642 Improved method for the isolation of biosurfactant glycolipids from Rhodococcus sp. Strain H13A. Bryant, F.O. (Univ. of Georgia, Athens (USA)). *Applied and Environmental Microbiology (USA),* 56(5): 1494-1496 (May 1990).

Rhodococcus sp. strain H13A (previously name Arthrobacter sp. strain H13A) degrades haxadecane and produces exocellular glycolipids, one or more of which are biosurfactants. An improved method for the isolation of the biosurfactant glycolipids by using XM 50 diafiltration and isopropanol precipitation was devised. This procedure was advantageous since it removes protein coisolated when the glycolipids are obtained by organic extraction and silicic acid chromatography. The protein apparently does not contribute any biosurfactant characteristics to the glycolipids. The deacylated glycolipid backbone included only a disaccharide.

47643 Selective delipidation of the plasma membrane by surfactants: Enrichment of sterols and activation of ATPase. Sandstrom, R.P. (Portland State Univ., OR (USA)); Cleland, R. *Plant Physiology (USA),* 90(4): 1524-1531 (Aug 1989).

The influence of plasma membrane lipid components on the activity of the H^+-ATPase has been studied by determining the effect of surfactants on membrane lipids and ATPase activity of oat (Avena sativa L.) root plasma membrane vesicles purified by a two-phase partitioning procedure. Triton X-100, at 25 to 1 (weight/weight) Triton to plasma membrane protein, an amount that causes maximal activation of the ATPase in the ATPase assay, extracted 59% of the membrane protein but did not solubilize the bulk of the ATPase. The Triton-insoluble proteins had associated with them, on a micromole per milligram protein basis, only 14% as much phospholipid, but 38% of the glycolipids and sterols, as compared with the native membranes. The Triton insoluble ATPase could still be activated by Triton X-100. When solubilized by lysolecithin, there were still sterols associated with the ATPase fraction. Free sterols were found associated with the ATPase in the same relative proportions, whether treated with surfactants or not. We suggest that surfactants activate the ATPase by altering the hydrophobic environment around the enzyme. We propose that sterols, through their interaction with the ATPase, may be essential for ATPase activity.

47644 A study of high oxidation state complexes of the type $[W(\eta^5\text{-}C_5Me_5)Me_2X]_2(\mu\text{-}N_2)$, including X-ray structures of $[W(\eta^5\text{-}C_5Me_5)Me_2(OC_6F_5)](\mu\text{-}N_2)$ and $[W(\eta^5\text{-}C_5Me_5)Me_2(S\text{-}2,4,6\text{-}C_6H_2Me_3)]_2(\mu\text{-}N_2)$. O'Regan, M.B. (Massachusetts Institute of Technology, Cambridge (USA)); Liu, A.H.; Finch, W.C.; Schrock, R.R.; Davis, W.M. *Journal of the American Chemical Society (USA),* 112(11): 4331-4338 (23 May 1990).

A high yield route (80-90%) to the bridging dinitrogen complex $[WCp^*Me_3]_2(\mu\text{-}N_2)$ (1) consists of the reduction of $WCp^*Me_3(OTf)$ by sodium amalgam in the presence of dinitrogen. 1 reacts with HOTf (2 or excess (6) equiv) to give $[WCp^*Me_2(OTf)]_2(\mu\text{-}N_2)$ or $[WCp^*Me(OTf)_2]_2(\mu\text{-}N_2)$, respectively, with C_6F_5COOH, C_6F_5OH, or C_6F_5SH to give complexes of the form $[WCp^*Me_2(X)]_2(\mu\text{-}N_2)$ (X = OC_6F_5, etc.), and with tetrabromocatechol to give $[WCp^*Me(O_2C_6Br_4)]_2(\mu\text{-}N_2)$. $[WCp^*Me_2(OTf)]_2(\mu\text{-}N_2)$ reacts with NaSR (R = 2,4,6-$C_6H_2Me_3$ or 2,4,6-C_6H_2-i-Pr_3) to give complexes of the form $[WCp^*Me_2(SR)]_2(\mu\text{-}N_2)$, and $[WCp^*Me(OTf)_2]_2(\mu\text{-}N_2)$ and $[WCp^*Me_2(S\text{-}2,4,6\text{-}C_6H_2Me_3)]_2(\mu\text{-}N_2)$ show that the complexes have structures that are similar to that of 1, except the N-N bond lengths are shorter.

47645 Preparation and characterization of two high oxidation state molybdenum dinitrogen complexes: $[MoCp^*Me_3]_2(\mu\text{-}N_2)$ and $[MoCp^*Me_3](\mu\text{-}N_2)[WCp'Me_3]$. Schrock, R.R. (Massachusetts Institute of Technology, Cambridge (USA)); Kolodziej, R.M.; Liu, A.H.; Davis, W.M.; Vale, M. G. *Journal of the American Chemical Society (USA),* 112(11): 4338-4345 (23 May 1990).

$[MoCp^*Cl_4]_2$ ($Cp^* = C_5Me_5$) is alkylated by MeMgCl in tetrahydrofuran to give red microcrystalline $MoCp^*Me_4$ in ~70% yield. $MoCp^*Me_4$ reacts with 1 equiv of $HOSO_2CF_3$ in ether to give purple microcrystalline $MoCp^*Me_3(OSO_2CF_3)$ in ~85% yield. Triflate can be displaced readily from $MoCp^*Me_3(OSO_2Cf_3)$ by adding LiOR (OR = pentafluorophenoxide, 2,6-diisopropylphenoxide, 2,6-dimethoxyphenoxide, 2,4,6-trimethoxyphenoxide, 2,6-dimethyl-4-methoxyphenoxide, and catecholate) in ether to yield complexes of the type $MoCp^*Me_3(OR)$ ($MoCp^*Me_2$(cat) in the case of catecholate) in 50-80% yield. The complexes can be oxidized chemically (with the exception of OR = pentafluorophenoxide and catecholate) by $[FeCp_2][PF_6]$ in methylene chloride to give complexes of the type $[MoCp^*Me_3(OR)][PF_6]$ as orange-brown microcrystalline powders in 80-90% yield. Addition of 3 equiv of hydrazine to $[MoCp^*Me_3(OR)][PF_6]$ in ether provides $[MoCp^*Me_3]_2(\mu\text{-}N_2)$ in low yield after purification by filtration through alumina and recrystallization from ether. $[MoCp^*Me_3]_2(\mu\text{-}N_2)$ belongs to the space group $P2_1/n$.

47646 Structure and stability of a DNA triple helix in solution: NMR studies on $d(T)_6 \cdot d(T)_6$ and its complex with a minor groove binding drug. Umemoto, Kimiko (State Univ. of New York, Albany (USA)); Sarma, Mukti H.; Gupta, Goutam; Luo, Jia; Sarma, Ramaswamy H. *Journal of the American Chemical Society (USA)*, 112(11): 4539-4545 (23 May 1990).

The possibility of both Watson-Crick and Hoogsteen A·T pairs can result in a triple helical structure for $d(T)_6 \cdot d(A)_6 \cdot d(T)_6$ in solution. In the triple helix the Watson-Crick paired T strand can run antiparallel, while the Hoogsteen paired T strand can run parallel to the A strand. On the basis of 1D/2D NMR studies, we have characterized the structural properties of the triple helix in terms of (a) nature of H-bonding, (b) chain conformations and relative chain orientations, (c) location of triplets T·A·T with respect to the helix axis, and (d) effects of NaCl and $MgCl_2$. In addition, we experimentally demonstrate that a minor groove specific drug Dst2 (a distamycin analogue) can bind to the triple helix. We show that the nature of thermal transition is altered by Dst2 binding; i.e., the host triple helix shows triple → coil (monophasic) transition in the absence of Dst2, while in its presence the helix shows a triplex → duplex → coil (biphasic) transition.

47647 Enzymes as synthetic catalysts: Mechanistic and active-site considerations of natural and modified chymotrypsin. West, J.B. (Research Institute of Scripps Clinic, La Jolla, CA (USA)); Hennen, W.J.; Lalonde, J.L.; Bibbs, J.A.; Zhong, Ziyang; Meyer, E.F. Jr.; Wong, Chihuey. *Journal of the American Chemical Society (USA)*, 112(13): 5313-5320 (20 Jun 1990). DOE Contract AC03-76SF00098.

This paper describes the mechanistic investigation of α-chymotrypsin and [Met_{192}-sulfoxide]-α-chymotrypsin-catalyzed peptide synthesis in a kinetically controlled process (i.e., aminolysis) and the relative stabilities of both enzymes in different conditions. Partitioning parameters for various nucleophiles (including D- and L-amino acids) competing with water for the acyl enzyme intermediate were determined. these parameters provide insights into the active-site geometries of both the native and the oxidized enzymes. α-Chymotrypsin with D-isomer selectivity in the hydrolysis of α-methyl-α-nitro esters was used for the synthesis of a D-L pseudopeptide. Molecular modeling together with kinetic results was used to explain the unusual phenomena in hydrolysis and synthesis catalyzed by the native and modified enzymes. α-Chymotrypsin methylated at the ϵ_2-N of the active-site histidine was shown to be an effective catalyst for peptide synthesis in the kinetically controlled process. No peptide bond hydrolysis was observed.

47648 Reactions of dimethylamine with multiply charged ions of cytochrome c. McLuckey, S.A. (Oak Ridge National Lab., TN (USA)); Van Berkel, G.J.; Glish, G.L. *Journal of the American Chemical Society (USA)*, 112(14): 5668-5670 (4 Jul 1990). DOE Contract AC05-84OR21400.

It has recently been demonstrated first by Fenn and co-workers and subsequently by other groups, that multiply charged ions from high-mass molecules can be formed from electrospray ionization. It is particularly noteworthy that proteins and peptides show a strong tendency for multiple cationization. The authors have recently coupled electrospray with a three-dimensional quadrupole (i.e., a Paul trap). This type of mass spectrometer is particularly well-suited for kinetic studies due to its ion-trapping and ion-isolation capabilities. They describe here results of the first systematic study of the near-thermal-energy ion/molecule reactions of a multiply protonated protein. These studies were carried out with a neutral reactant, dimethylamine that has proven to be a selective base.

5503 Cytology

Refer also to citation(s) 47625

47649 Isolation of guard cell protoplasts from mechanically prepared epidermis of Vicia faba leaves. Kruse, T. (Pepperdine Univ., Malibu, CA (USA)); Tallman, G.; Zeiger, E. *Plant Physiology (USA)*, 90(4): 1382-1386 (Aug 1989).

A method for isolating guard cell protoplasts (GCP) from mechanically prepared epidermis of Vicia faba is described. Epidermis was prepared by homogenizing leaves in a Waring blender in a solution of 10% Ficoll, 5 millimolar $CaCl_2$, and 0.1% polyvinylpyrrolidone 40 (PVP). Attached mesophyll and epidermal cells were removed by shaking epidermis in a solution of Cellulysin, mannitol, $CaCl_2$, PVP, and pepstatin A. Cleaned epidermis was transferred to a solution of mannitol, $CaCl_2$, PVP, pepstatin A, cellulase Onozuka RS, and pectolyase Y-23 for the isolation of GCP. Preparations made by this method included both adaxial and abaxial GCP and contained ≤0.017% mesophyll protoplasts, ≤0.6% mesophyll fragments, and no epidermal cell contaminants. Yields averaged 9×10^4 protoplasts/leaflet and 98 to 100% of the GCP excluded trypan blue, concentrated neutral red, and hydrolyzed fluorescein diacetate. Isolated GCP increased in diameter by 2.2 micrometers after incubation in darkness in 10 micromolar fusicoccin, 0.4 molar mannitol, 5 millimolar KCl, and 1 millimolar $CaCl_2$. Illumination of GCP with 800 micromoles per square meter per second of red light resulted in alkalinization of their suspension medium. When 10 micromolar per square meter per second of blue light was superimposed onto the red light background, the medium acidified. Measurements of chlorophyll a fast fluorescence transients from isolated GCP indicated that GCP were capable of electron transport, and slow transients contained the M peak usually associated with a functional photosynthetic carbon reduction pathway.

5504 Genetics

Refer also to citation(s) 46364, 46772

47650 (CONF-8808142–Absts.) **Genetics and the unity of biology: Abstracts.** Moens, P.B. (ed.). National Research Council of Canada, Ottawa, ON (Canada). ©[1988]. 535p. Sponsored by U.S. DOE Energy Research; National Research Council of Canada. DOE Contract FG02-88ER60682. From 16. international congress of genetics; Toronto (Canada); 20-27 Aug 1988. Source: National Research Council of Canada, Ottawa, Canada K1A 0R6.

Published in Genome; 30: Suppl. 1, 1-535 (1988).

This volume contains abstracts from documents presented at the 16th International Congress of Genetics meeting. (KJD)

47651 (ORNL/FTR–3704) **[Mechanisms of tolerance and resistance]: Foreign trip report, August 3, 1990–August 14, 1990.** Waters, L.C. Oak Ridge National Lab., TN (USA). 28 Aug 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016503. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in the Seventh International Congress of Pesticide Chemistry by presenting a poster entitled "Studies on the Expression of Insecticide Resistance-Associated Cytochrome P450 in Drosophila Using Cloned DNA" and as an invited speaker in the Workshop Session on Insecticide Resistance. The Congress covered a wide range of topics, including studies of new syntheic compounds and natural products with crop protecting properties, modes of action of pesticides, mechanisms of pesticide resistance, environmental fate of pesticides and estimates of risk to pesticide exposure. Several presentations on the potential role of cytochrome P450 in resistance to insecticides and herbicides were relevant to our work at ORNL's Biology Division on molecular mechanisms of P450 expression.

47652 (SRO-NERP–20) **Endangered, threatened, and rare vascular flora of the Savannah River Site.** Knox, J.N.; Sharitz, R.R. Savannah River Ecology Lab., Aiken, SC (USA). 1990. 147p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-76SR00819. Order Number DE90017255. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report summarizes information on the 30 endangered, threatened, or rare plants found on the Savannah River Site, Aiken, South Carolina. Of these 30 species, eight are under review by the US Fish and Wildlife Service as possible candidates for the proposed threatened and endangered list. Twenty-seven of the species are on the state of South Carolina's list prepared by the South Carolina Advisory Committee on Rare, Threatened, and Endangered Vascular Plants. These 27 plants include regionally threatened species, statewide threatened species, and rare species. Approximately two-thirds of these plants are found in wetland habitats. Also included in this report are summaries of 29 plant species that are likely to occur on the SRS, but have not been found there. Fourteen of these plants are on the federal list and range in status from endangered to possible candidates for deletion from the list. Twenty-eight are on the state of South Carolina list; approximately two-thirds of these also occur in wetland habitats. 31 refs., 45 figs., 2 tabs.

5505 Metabolism

Refer also to citation(s) 47632, 47686

47653 (EPRI-NP–6946) **Soil-to-plant transfer of carbon-14 for environmental assessment of radioactive waste repositories: Final report.** Sheppard, M.I.; Sheppard, S.C.; Amiro, B.D.; Schwartz, W.J.; Hawkins, J.L.; Thibault, D.H. Electric Power Research Inst., Palo Alto, CA (USA); Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. ©Aug 1990. 61p. Sponsored by Electric Power Research Institute. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

Transport of ^{14}C through soil was studied by applying ^{14}C tracers to soils in outdoor lysimeters. The tracers were applied as either carbonate or organic PCB to either the top or bottom of undisturbed cores of two different soil types. The carbonate tracer moved rapidly through the soil, probably in a vapor phase. The PCB was much less mobile. One of the soil types was more acidic with a low concentration of native carbonates, and ^{14}C transport was more rapid through this soil than through the less acidic, high-carbonate soil. We calculated solid/liquid partition coefficients (K_d) for ^{14}C-carbonate of 6 and 1.2 mL/g for the two soils, respectively. Plant uptake of ^{14}C applied as carbonate or as PCB was measured from two soil types in outdoor lysimeters. The carbonate was rapidly volatilized from both soils. The plant/soil concentration ratio (CR) for ^{14}C-carbonate was 0.7 for the more acidic soil and 1.3 for the less acidic soil, on a dry weight basis. 41 refs., 7 figs., 5 tabs.

47654 **Douglas-fir dry weight partitioning under competition for limited nitrogen.** Coleman, M.D. (Univ. of Washington, Seattle (USA)); Friend, A.L. *Plant Physiology, Supplement (USA),* 89(4): 39 (Apr 1989).

In contrast to field studies where Douglas-fir fine root productivity can be inversely correlated with available N, root growth of Douglas-fir seedlings raised individually either remains constant or increases in response to N additions. We hypothesized that in a competitive situation seedling root weight would decline with increasing N availability. To examine the effect of N supply on biomass partitioning under competition, seedlings were raised at 2x2 cm spacing under three levels of N in 16x16x16 cm sand-filled containers and subsampled three times during growth. Increasing N availability caused a shift in biomass partitioning at the final harvest; mean root-shoot ration exceeded 1.7 for N stressed treatments and was 0.53 for the high N treatment. Root biomass increased between the 5 and 25 ppm N levels from 110 mg to 287 mg, but remained near 300 mg between 25 and 100 ppm N. Shoot biomass increased linearly. In contrast to the hypothesis, root growth was not inversely correlated with available N.

47655 **Metabolism of one-carbon compounds by the ruminal acetogen syntrophococcus sucromutans.** Dore, J. (Univ. of Illinois, Urbana (USA)); Bryant, M.P. *Applied and Environmental Microbiology (USA),* 56(4): 984-989 (Apr 1990).

Syntrophococcus sucromutans is the predominant species capable of O demethylation of methoxylated lignin monoaromatic derivatives in the rumen. The enzymatic characterization of this acetogen indicated that it uses the acetyl coenzyme A (Woods) pathway. Cell extracts possess all the enzymes of the tetrahydrofolate pathway, as well as carbon monoxide dehydrogenase, at levels similar to those of other acetogens using this pathway. However, formate dehydrogenase could not be detected in cell extracts, whether formate or a methoxyaromatic was used as electron acceptor for growth of the cells on cellobiose. Labeled bicarbonate, formate, [1-^{14}C] pyruvate, and chemically synthesized O-[methyl-^{14}C] vanillate were used to further investigate the catabolism of one-carbon (C_1) compounds by using washed-cell preparations. The results were consistent with little or no contribution of formate dehydrogenase and pointed out some unique features. Conversion of formate to CO_2 was detected, but labeled formate predominantly labeled the methyl group of acetate. Labeled CO_2 readily exchanged with the carboxyl group of pyruvate but not with formate, and both labeled CO_2 and pyruvate predominantly labeled the carboxyl group acetate. No CO_2 was formed from O demethylation of vanillate, and the acetate produced was position labeled in the methyl group. The fermentation pattern and specific activities of products indicated a complete synthesis of acetate from pyruvate and the methoxyl group of vanillate.

47656 **Sucrose metabolism in lima bean seeds.** Xu, Dianpeng (Univ. of Georgia, Athens (USA)); Sung, Shijean, S.; Black, C.C. *Plant Physiology (USA),* 89(4): 1106-1116 (Apr 1989).

Developing and germinating lima bean (Phaseolus lunatus var Cangreen) seeds were used for testing the sucrose synthase pathway, to examine the competition for uridine diphosphate (UDP) and pyrophosphate (PPi), and to identify adaptive and maintenance-type enzymes in glycolysis and gluconeogenesis. In developing seeds, sucrose breakdown was dominated by the sucrose synthase pathway; but in the seedling embryos, both the sucrose synthase pathway and acid invertase were active. UDPase activity was low and seemingly insufficient to compete for UDP during sucrose metabolism in seed development or germination. In contrast, both an acid and alkaline pyrophosphatase were active in seed development and germination. The set of adaptive enzymes identified in developing seeds were sucrose synthase, PPi-dependent phosphofructokinase, plus acid and alkaline pyrophosphatase; and, the adaptive enzymes identified in germinating seeds included the same set of enzymes plus acid invertase. The set of maintenance enzymes identified during development, in the dry seed, and during germination were UDP-glucopyrophosphorylase, neutral invertase, ATP and UTP-dependent fructokinase, glucokinase, phosphoglucomutase, ATP and UTP-dependent phosphofructokinase and sucrose-P synthase.

47657 **Identification of actively filling sucrose sinks.** Sung, Shijean S. (Univ. of Georgia, Athens (USA)); Xu, Dianpeng; Black C.C. *Plant Physiology (USA),* 89(4): 1117-1121 (Apr 1989).

Certain actively filling plant sucrose sinks such as a seed, a tuber, or a root can be identified by measuring the uridine diphosphate and pyrophosphate-dependent metabolism of sucrose. Sucrolysis in both active and quiescent sucrose sinks was tested and sucrose synthase was found to be the predominant sucrose breakdown activity. Sucrolysis via invertases was low and secondary in both types of sinks. Sucrose synthase activity dropped markedly, greater than fivefold, in quiescent sinks. The test are consistent with the hypothesis that the sucrose filling activity, i.e. the sink strength, of these plant sinks can be measured by testing the uridine diphosphate and pyrophosphate-dependent breakdown of sucrose. Measuring the initial reactions of sucrolysis shows much promise for use in agriculture crop and tree improvement research as a biochemical test for sink strength.

47658 **Inhibition of chloroplastic respiration by osmotic dehydration.** Willeford, K.O. (Brandeis Univ., Waltham, MA (USA)); Ahluwalia, K.J.K.; Gibbs, M. *Plant Physiology (USA),* 89(4): 1158-1160 (Apr 1989). DOE Contract AC02-76ER03231.

The respiratory capacity of isolated spinach (Spinacia oleracea L.) chloroplasts, measured as the rate of $^{14}CO_2$ evolved from the oxidative pentose phosphate cycle in darkened chloroplasts exogenously supplied with [^{14}C]glucose, was progressively diminished by escalating osmotic dehydration with betaine or sorbitol. Comparing the inhibitions of CO_2 evolution generated by osmotic dehydration in chloroplasts given C-1 and C-6 labeled glucose, 54% and 84%, respectively, indicates that osmotic dehydration effects to a greater extent the recycling of the oxidative pentose phosphate intermediates, fructose-6P and glyceraldehyde-3P. Respiratory inhibition in the darkened chloroplast could be alleviated by addition of NH_4Cl (a stromal alkylating agent), iodoacetamide (an inhibitor of glyceraldehyde-3P dehydrogenase), or glycolate-2P (an inhibitor of phosphofructokinase). It is concluded that the site which primarily mediates respiratory inhibition in the darkened chloroplast occurs at the fructose 1,6-bisphosphatase/phosphofructokinase junction.

47659 **Dependence of ethanolic fermentation, cytoplasmic pH regulation, and viability on the activity of alcohol dehydrogenase in hypoxic maize root tips.** Roberts, J. (Univ. of California, Riverside (USA)); Chang, Keejong; Webster, C.; Callis, J.; Walbot, V. *Plant Physiology (USA)*, 89(4): 1275-1278 (Apr 1989).

We examined the role of alcohol dehydrogenase (ADH) in the metabolism and survival of hypoxic maize (Zea mays L.) root tips. The dependence of the rate of ethanolic fermentation, cytoplasmic pH, and viability on the activity of ADH in maize root tips during extreme hypoxia was determined. Maize lines with ADH activities differing over about a 200-fold range were studied. Effects of genetic background were controlled by comparing pairs of F4 progeny of crosses between mutant (low ADH activity) and reference inbred lines. The capacity of hypoxic root tips to perform ethanolic fermentation exhibited a dependence on ADH activity only at activities found in Adh 1 nulls. The ability of maize root tips to withstand prolonged and extreme hypoxia was likewise independent of ADH activity, except at the lowest activities. Root tips that exhibited lower tolerance of hypoxia had more acidic cytoplasm during extreme hypoxia. We conclude that the activity of ADH in normal maize root tips does not limit the capacity for energy production via fermentation, and does not determine viability under extreme hypoxia. The significance of the induction of ADH activity in plants by hypoxia is discussed.

47660 **Models for bacteriorhodopsin-catalyzed dark cis-trans isomerization of bound retinal.** Seltzer, S. (Brookhaven National Laboratory, Upton, NY (USA)). *Journal of the American Chemical Society (USA)*, 112(11): 4477-4483 (23 May 1990). DOE Contract AC02-76CH00016.

The syntheses of syn- and anti-2-aza-6-carboxymethylbicyclo[2.2.2]octane and syn and anti-2-aza-6-carboxypropyl[2.2.2]octane zwitterions are described. These compounds, which have secondary amines to form positively charged Schiff bases with retinal and a pendant carboxylate anion to interact with the polyeniminium system, mimic the presence of aspartate-212 and lysine-216 at the retinal binding/cis-trans isomerization site of bacteriorhodopsin. Kinetics of retinal cis-trans isomerization of these model compounds are reported and are discussed in light of previous MNDO calculations (J. Am. Chem. Soc. 1987, 109, 1627-1631) of isomerization barrier heights affected by the movement of an anion to different positions with respect to the polyeniminium system.

47661 **Photoinduced spin-polarized radical ion pair formation in a fixed-distance photosynthetic model system at 5 K.** Wasielewski, M.R. (Argonne National Laboratory, IL (USA)); Gaines, G.L. III; O'Neil, M.P.; Svec, W.A.; Niemczyk, M.P. *Journal of the American Chemical Society (USA)*, 112(11): 4559-4560 (23 May 1990). DOE Contract W-31-109-ENG-38.

Photoinduced, multistep charge separation in bacterial reaction centers proceeds from the lowest excited singlet state of the dimeric bacteriochlorophyll electron donor in two steps, to yield a weakly interacting dimer cation-quinone anion radical pair, P^+-Q^-, separated by 28 Å. Recently, we developed criteria for achieving high quantum yield charge separation in porphyrin-based-donor-acceptor systems at cryogenic temperatures. Using this information as a predictive model, we synthesized compound 1, TAPD-ZP-NQ, which consists of a zinc porphyrin primary electron donor, ZP, positioned between a naphthoquinone electron acceptor, NQ, and an N,N,N,N-tetraalkyl-p-phenylenediamine secondary electron donor, TADP.

47662 **Formation and properties of a $NiFe_3S_4$ cluster in Pyrococcus furiosus ferredoxin.** Conover, R.C. (Univ. of Georgia, Athens (USA)); Park, J.B.; Adams, M.W.W.; Johnson, M.K. *Journal of the American Chemical Society (USA)*, 112(11): 4562-4564 (23 May 1990).

The NiFe-enzyme CO dehydrogenase (or acetyl-CoA synthase) catalyzes CO oxidation in vitro and the formation of a carbon-carbon bond in vivo. EPR studies of the enzyme from the acetogen Clostridium thermoaceticum and from the methanogen Methanosarcina thermophila have provided evidence for a CO-binding, NiFe-containing catalytic site, in addition to multiple Fe-S clusters. Here we report evidence for the formation of a $[NiFe_3S_4]^+$ center in Pyrococcus furiosus ferredoxin (Fd) and EPR characterization of the ground-state properties of this novel mixed-metal cluster.

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Refer also to citation(s) 46729, 47874, 47875

47663 (AD-A-222163/8/XAB) **Study of the cost-savings potential of the Military - Civilian Health Services Partnership Program in the nuclear medicine and radioimmunoassay services at Ireland Army Community Hospital, Fort Knox, Kentucky. Master's thesis, July 1987-July 1988.** Amon, T.M. Academy of Health Sciences (Army), Fort Sam Houston, TX (USA). Health Care Administration. Jan 1989. 94p. (HCA-109-89). Source: NTIS, PC A05/MF A01.

Using workload data for Calendar Year 1987, a cost savings analysis was performed on the following three options (involving the Nuclear Medicine Department at Ireland Army Community Hospital); (1) Elimination of Radioimmunoassay Internal Service, (2) Civilian Military Health Service Partnership Program and (3) Fixed price contract for Nuclear Medicine Services. This study revealed the Civilian-Military Health Services Partnership Program would potentially generate the greatest cost savings and recommended that it be implemented in other areas throughout the Army Medical Department.

47664 (BIR-18) **Technical and physical parameters for quality assurancce in medical diagnostic radiology: Tolernces, limiting values and appropriate measuring methods.** Moores, B.M. (Radiation Protection Service, Liverpool (UK)); Stieve, F.E.; Eriskat, H. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. 165p. (CONF-8802161--: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR-11620). Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Individual papers are indexed separately.

47665 (BIR-18, pp. 100-102) **Absolute efficiencies of X-ray screens for fluoroscopy.** Giakoumakis, G.E. (Ioannina Univ. (Greece). Dept. of Physics). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161--: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR-11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The absolute X-ray efficiencies of phosphor screens made of various materials (ZnCdS:Ag, CsI:Na, Y_2O_2S:Tb, Gd_2O_2S:Tb, $CaWO_4$ and ZnS:Cu) are reported. The measurements have been carried out under fluoroscopic conditions for tube voltages ranging from 50 to 250 kV and for screen weights from 20 to 200 mg cm^{-2}. There is also, for comparison, a set of measurements concerning the behaviour of the screens under soft X-rays (20-50 kV) excitation. All the experimental results are discussed on the basis of an improved Hammaker-Ludwig model and analytical expressions are presented permitting the theoretical calculation of the absolute efficiency of the screens. (author).

47666 (BIR–18, pp. 102-104) **Computer-supported quality control in X-ray diagnosis.** Maier, W. (Zentralklinikum Augsburg (Germany, F.R.). Inst. fuer Roentgendiagnostik); Klotz, E.; Schlicke, K-M. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Quality control of X-ray facilities in radiological departments of large hospitals is possible only if the instrumentation used for measurements is interfaced to a computer. The central computer helps to organize the measurements as well as analyse and record the results. It can also be connected to a densitometer and camera for evaluating radiographs of test devices. Other quality control tests are supported by a mobile station with equipment for non-invasive dosimetry measurements. Experience with a computer-supported system in quality control of film and film processing is described and the evaluation methods of ANSI and the German industrial standard DIN are compared. The disadvantage of these methods is the exclusion of film quality parameters, which can make processing control almost worthless. (author).

47667 (BIR–18, pp. 104-106) **The results of a quality-control programme in mammography.** Ramsdale, M.L. (Saint Luke's Hospital, Guildford (UK)); Hiles, P.A. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

With the introduction of a breast screening programme in the UK, quality assurance in mammography is of paramount importance in assuring optimum imaging performance with low dose. Quality control checks are an essential part of the quality-assurance system. A quality-control programme at a breast screening clinic is described. Daily checks include film sensitometry for X-ray processor control and radiography of a lucite phantom to monitor the consistency of the X-ray machine automatic exposure control. Weekly checks include additional measurements on the performance of the automatic exposure control for different breast thickness and an overall assessment of image quality using a prototype mammography test phantom. The test phantom measures low-contrast sensitivity, high-contrast resolution and small-detail visibility. The results of the quality-control programme are presented with particular attention paid to tolerances and limiting values. (author).

47668 (BIR–18, pp. 107-110) **The influence of scattered radiation on recording systems and quality-assurance test parameters.** Stargardt, A. (Klinikum der Rheinisch-Westfaelischen Technischen Hochschule, Aachen (Germany, F.R.)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Scattered radiation generated in patient and imaging system has to be considered when quality-assurance tests involve dose detection or image-quality estimations. Measurement of automatic-exposure control dose can be altered by backscattering from intensifying screens of more than 10% and the equipment transmission factor can be overestimated up to a factor of 10 when only primary radiation is used. The sensitivity of intensifying screens depends on the angle of incidence of the radiation and so primary and scattered radiation are detected differently. The quality-control aspects of anti-scatter grids are discussed. (author).

47669 (BIR–18, pp. 110-112) **Modulation transfer function evaluation of screen-film systems by the grating method.** Esch, R. Van (Agfa-Gevaert N.V., Mortsel (Belgium)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The classical grating method to evaluate the modulation transfer function (MTF) of screen-film systems has been examined with the aim of enhancing accuracy and reproducibility. Optimized grating geometry, exposure conditions, microdensitometric measurements and data analysis led to reproducibility better than 1%. The influence of different sources of systematic errors, such as the scattering of the grating, is evaluated and the total bias on this MTF-evaluation method is expected to be less than 3%. (author).

47670 (BIR–18, pp. 113-116) **Image unsharpness: two methods to express image unsharpness in one value.** Haan, R.A. de (Univ. of Utrecht (Netherlands). Dental School); Sanderink, G.C.H.; Aken, J. van. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Two methods to express image unsharpness in one value are compared. The first method is commonly used and uses the noise-equivalent passband or its reciprocal value the equivalent blur ($1/N_e$) determined from the modulation transfer function (MTF). A radiographic image of a sharp edge is made and scanned by a microdensitometer and the film density is transferred into energy

values with the use of the characteristic curve. After differentiation, a Fourier transform results in an MTF curve. A single value (N_e) substituting the complete MTF curve can be derived by integrating the squared MTF values over frequency. This noise-equivalent passband is expressed in 1p mm^{-1}. $1/N_e$ is the equivalent blur (or sampling aperture) expressed in millimetres. The second method for determining the unsharpness derives a value from the energy-related edge response function, which will be called the equivalent unsharpness. Both methods use the same reference unsharpness, which indicates that the "equivalent blur" and the "equivalent unsharpness" are comparable values qualifying image unsharpness. Results of practical tests using both methods show that the values are practically the same. However, the second method is relatively simple and therefore an attractive tool for determining image unsharpness. (author).

47671 (BIR–18, pp. 116-117) **Multi-format cameras.** Moores, B.M. (Christie Hospital and Holt Radium Inst., Manchester (UK)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A method for calibrating and assessing the performance of multi-format cameras is described. The technique employs an electronically generated test phantom with appropriate grey-scale and resolution patterns incorporated within it. Tolerances and limiting values for both the phantom signals and resulting radiographic images are indicated. (author).

47672 (BIR–18, pp. 117-120) **Quality assurance in digital radiography.** Busch, H.P. (Heidelberg Univ., Mannheim (Germany, F.R.). Fakultaet fuer Klinische Medizin); Lehmann, K.J. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

At present, there is no standard way of evaluating performance characteristics of digital radiography systems. Continuous measurements of performance parameters are necessary in order to obtain images of high quality. Parameters of quality assurance in digital radiography, which can be evaluated with simple, quick methods, are spatial resolution, low-contrast detectability, dynamic range and exposure dose. Spatial resolution was determined by a lead bar pattern, whereas the other parameters were measured by commercially available phantoms. Performance measurements of 10 digital subtraction angiography (DSA) units and one digital radiography system for unsubtracted digital radiography were assessed. From these results, recommendations for performance parameter levels will be discussed. (author).

47673 (BIR–18, pp. 120-122) **Quality control measurements of X-ray image-intensifier television chain systems.** Henshaw, E.T. (Radiation Protection Service, Liverpool (UK)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The test methods and limiting values for the following basic parameters of an image intensifier TV system are presented in relation to (a) acceptance tests and (b) constancy tests: automatic gain and brightness control, video voltage output, monitor check (grey scale), geometric distortion, noise (low-contrast detectability), overall imaging ability, limiting resolution, uniformity of resolution, conversion factor, contrast ratio and measurement of field size. Several of these tests make use of the Leeds Test Objects. (author).

47674 (BIR–18, pp. 122-125) **Measurement of the uniformity of X-ray image-intensifier television systems and of the system components.** Cooney, P. (Federated Dublin Voluntary Hospitals (Ireland)); Maher, K.P.; Malone, J.F. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Uniformity is a well defined term used to describe the response of a gamma camera to a "uniform" radiation input. A similar quantity is required in the specification of the image-intensifier (II) television (TV) chains used in fluoroscopic imaging, particularly in vascular, cardiac and digital applications. This paper presents work on the use of the National Electrical Manufacturers' Association definition of uniformity for gamma cameras and its refinement for application in the field with II-TV chains as whole systems. The methods of measurement employed using on-site high-quality videotape recording combined with an off-site and off-line digital image processor are described. The impact of noise reduction and matrix size on the results in outlined. The contribution of individual components of the chain to the non-uniformity have also been assessed in detail using methods of measurement and definitions specifically developed to be suitable for application in the hospital environment by an experienced physicist. The methods and results for (i) the X-ray beam, (ii) the image intensifier and (iii) the TV system are presented. These methods have been tested by applying them to a sample of 10 II-TV systems in routine hospital use and the results are reported. (author).

47675 (BIR–18, pp. 125-127) **Measurement of image-intensifier veiling glare.** Faulkner, K. (Newcastle General Hospital (UK)); Louka, M. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Veiling glare is caused by the scattering of light and electrons in an image intensifier and results in a loss of contrast in fluoroscopic images. Veiling glare may be characterized by two parameters: the

mean scattering length and scattering percentage. The veiling glare point spread function and modulation transfer function (MTF) may be deduced from contrast ratio measurements. Three different methods of measuring contrast ratio were investigated: photographic, photometric and digital. Measurements were made on three different image intensifiers, two linked to a digital fluorography system, while the other was conventional. Lead disks with a range of diameters from 18 to 50 mm were placed as close as possible to the image intensifier's input surface at the centre of the field. The X-ray beam was filtered with 1 mm copper. The results obtained using the three methods and the imaging performance of the various parts of the intensifier system were compared. This method of determining the performance of image intensifiers is of practical importance as it is not necessary to perform Fourier transforms on the image to deduce the MTF. The application of the digital method of determining contrast ratios to the routine quality assurance of digital fluorography systems is mentioned. (author).

47676 (BIR–18, pp. 127-128) **Quality control of image-intensifier television chains in Finland.** Pirinen, M. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161– : Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

There are still some 500 image-intensifier television (TV) chains connected to fluoroscopic units in Finland. Most of them were installed in the 1970s, although the oldest still in use date back to the late 1960s. In order to establish the performance levels of the chains, some 300 of them were assessed in 1982 by the Finnish Centre for Radiation and Nuclear Safety (STUK). The results of this study, as expected, showed great diversity in the condition of the chains. The main reason for this was the lack of periodical quality assurance of the chains. Recommendations for limits were established from the results of assessing three parameters that describe the condition of the chains: spatial resolution, automatically controlled dose-rate and contrast sensitivity. The recommendations also advise hospitals on how to arrange alternative quality assurance measurements and observations. This can be done either by the hospital's maintenance staff, the manufacturer, or the supervising authority (STUK). The results following adoption of the recommendations by hospitals are presented. (author).

47677 (BIR–18, pp. 129-135) **Physiological conditions for the effective interpretation of radiographic images.** Overington, I. (British Aerospace, plc, Bristol (UK). Sowerby Research Centre). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161– : Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A wide range of factors influence the ability of the human observer to perceive detail in images. Most of these factors are of some significance in interpretation of one or more types of radiographic image. Human observer performance may be conveniently categorized in terms of multiparametric threshold surfaces, suprathreshold visibility and observer variance. The general multiparametric trends of human threshold performance are discussed, together with the implications for visibility. The importance and implications of observer variance are then explored, with particular reference to their effects on search processes. Finally, attempts are made to highlight the implications of some of the factors on typical radiographic interpretation tasks and on the adequacy of certain types of phantom image used for equipment calibration. (author).

47678 (BIR–18, pp. 135-137) **Quality control of radiographic illuminators and associated viewing equipment.** Hartmann, E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz); Stieve, F-E. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161– : Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Conditions for viewing radiological images should be adapted to the characteristics of the radiographic films as they can influence the diagnostic accuracy and detection of threshold contrasts of smaller diagnostically important structures. Since the optimal detection of small contrast details and small structures lies in the region of 1000 cd m^{-2}, this value should be met by the viewing conditions. Data on test procedures, frequency of tests, optimum light intensities and tolerance criteria are given, based on existing recommendations. Procedures for testing the viewing conditions should be included in quality assurance programmes. (author).

47679 (DOE/ER/60434–5) **Boron in nuclear medicine: New synthetic approaches to PET, SPECT and BNCT agents: Progress report, March 1, 1990–February 28, 1991.** Kabalka, G.W. Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry. Oct 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER60434. Order Number DE90017335. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The primary objective of the Department of Energy (DOE) Nuclear Medicine Program at the University of Tennessee is the creation of new methods for introducing short-lived isotopes into agents for use in PET and SPECT. A small, but significant portion of our effort is directed toward the design of boron-containing neutron therapy agents. The uniqueness of the UT program is its focus on the design of new chemistry (molecular architecture) and technology as opposed to the application of know reactions to the synthesis of specific radiopharmaceuticals. The new technology is then utilized in nuclear medicine research at the UT Biomedical Imaging Center and in collaboration with colleagues at other DOE facilities (Brookhaven National Laboratory, Oak Ridge National Laboratory, Los Alamos National Laboratory, and Oak Ridge Associated Universities). An important goal of the DOE Nuclear Medicine Program at UT is to provide training for students (predoctoral and postdoctoral) in the scientific aspects of nuclear medicine. The academic nature of the program facilitates collaborative interactions with other DOE nuclear medicine programs and helps to insure the continued availability of skilled scientists dedicated to the advancement of nuclear medicine.

47680 (INIS-mf–12694) **PSI life sciences newsletter 1988: PSI annual report 1988 annex II.** Schubiger, P.A. (ed.) (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Oct 1989. 58p. Order Number DE90639769. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Even as separate institutes, the EIR (Eidg. Institut fuer Reaktorforschung) and the SIN (Schweiz. Institut fuer Nuklearforschung) made use of ionizing radiation and radioactivity in medical diagnosis and therapy. After their fusion into a national laboratory, the Paul Scherrer Institute (PSI), these projects were combined with those of the Radiation Protection Group and the Life Sciences Department was formed. In equality with the departments of Nuclear

and Particle Physics, Condensed Matter and Materials Sciences, and Energy Research and Engineering Sciences, the department of Life Sciences is one of the major pillars of the new center. The activities are divided into three areas: radiation medicine, radiopharmacy, and radiation protection. The goal of the first two is to develop social and economic uses of radioactivity and elementary particles. The Division of Radiation Medicine proposes to achieve this through the development of original, dynamic and conformal tumor therapy with charged particles and the Division of Radiopharmacy through the investigation into, and the production of, highly specific diagnostic systems for SPECT, PET and MRI and the investigation of the use of radionuclides in therapy. The third division, Radiation Protection, evaluates the risks of ionizing radiation in biology and the ecosphere and proposes adequate protection measures. The present report describes, in the first section, the outstanding scientific results of the past year and, in the second section, gives a progress report on the on-going programs. It is the first report in this style, but it can be considered as a continuation of the earlier Medical Newsletter of SIN. (author) 59 figs., 19 tabs., 61 refs.

47681 (IPEN-PUB-215) **Development of a solid phase technic for radioimmunoassay of triiodothyronine (T_3) in serum.** Hamada, M.M.; Mesquita, C.H.; Silva, C.P.G. da. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Oct 1988. 18p. (In Portuguese). Order Number DE90639856. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We have developed a solid phase radioimmunoassay (RIA) system for triiodothyronine (T_3), by immobilizing triiodothyronine antibodies on the inner wall of reaction tubes. The antibody-coated tubes were made via reaction of antibody with glutaraldeyde residue pre coated on the inner wall of the tubes by alkaline self-polimerization. The quality of the coated tubes was tested through its performance in the RIA methodology, by analysing the following RIA parameters: minimum detectable dose (MDD), nonspecific binding (NSB), "$X_{50\%}$", slope of the standard curve, intra and inter-assay precision, accuracy of the method and figure of merit. The serum levels of T_3 in hypothyroid and hyperthyroid patients and the normal values range were determined for the solid phase RIA system. The results are in agreement with found in the literature. (author).

47682 (LA-UR-90-2854) **Biomedical applications on laser technology at Los Alamos.** Bigio, I.J.; Loree, T.R. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-9008142-1: Laser applications in life science, Moscow (USSR), 17-31 Aug 1990). Order Number DE90016447. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Los Alamos has a long history of research in laser technology, and over the past few years we have begun to build a program directing some of that technology to a variety of applications in biology and medicine. As examples, two of these activities will be described in this manuscript: the use of a laser interferometer to measure the microwave absorption spectrum of DNA, and spectral measurements of the secondary light produced during laser corneal ablation.

47683 (LBL-26633) **Bayesian image reconstruction: Application to emission tomography.** Nunez, J.; Llacer, J. Lawrence Berkeley Lab., CA (USA). Feb 1989. 56p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90016621. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In this paper we propose a Maximum a Posteriori (MAP) method of image reconstruction in the Bayesian framework for the Poisson noise case. We use entropy to define the prior probability and likelihood to define the conditional probability. The method uses sharpness parameters which can be theoretically computed or adjusted, allowing us to obtain MAP reconstructions without the problem of the "grey" reconstructions associated with the pre Bayesian reconstructions. We have developed several ways to solve the reconstruction problem and propose a new iterative algorithm which is stable, maintains positivity and converges to feasible images faster than the Maximum Likelihood Estimate method. We have successfully applied the new method to the case of Emission Tomography, both with simulated and real data. 41 refs., 4 figs., 1 tab.

47684 **A new bifunctional chelate, $BrMe_2HBED$: An effective conjugate for radiometals and antibodies.** Mathias, C.J. (Washington Univ. School of Medicine, St. Louis, MO (USA)); Connett, J.M.; Philpott, G.W.; Welch, M.J.; Sun, Yizhen; Martell, A.E. *Inorganic Chemistry (USA),* 29(8): 1475-1480 (18 Apr 1990). DOE Contract FG02-87ER60512.

A new bifunctional chelate, N-(2-hydroxy-3,5-dimethylbenzyl)-N′-(2-hydroxy-5-(bromoacetamido)benzyl)ethylenediam acid ($BrMe_2HBED$), was designed and synthesized to bind trivalent cationic metals with monoclonal antibodies. The stability constants (log values) for indium complexed with a similar ligand, HBED, were increased over those of more commonly used ligands DTPA and EDTA. Predictably, the increased metal-ligand complex stability would expedite the in vivo clearance from nontarget regions and perhaps enhance the localization of the radiolabeled antibody (Ab). $BrMe_2HBED$ was conjugated with the Ab (24 h) and then radiolabeled with indium-111 citrate (24 h). Additionally, the Ab was radiolabeled by using conventional methods (^{111}In-DTPA and ^{125}I-lactoperoxidase) and then compared by measuring the in vitro stability, in vitro immunoreactivity(IR), and in vivo distribution and clearance. A 10:1 $BrMe_2$ HBED:Ab mole ratio resulted in good labeling efficiency with ^{111}In and more importantly a very high IR. In a hamster tumor model, ^{111}In-$BrMe_2$ HBED-labeled monoclonal antibody (1A3) had high uptake in the tumor tissue and preferable blood clearance compared to either of the more conventional radiolabeled 1A3 monoclonal antibodies (^{111}In-DTPA or ^{125}I-lactoperoxidase). 49 refs., 4 figs., 8 tabs.

47685 **Synthesis of (R)-(-)- and (S)-(+)-4-fluorodeprenyl and (R)-(-)- and (S)-(+)-[N-^{11}C-methyl]-4-fluorodeprenyl and positron emission tomography studies in baboon brain.** Plenevaux, A. (Brookhaven National Laboratory, Upton, NY (USA)); Dewey, S.L.; Fowler, J.S.; Guillaume, M.; Wolf, A.P. *Journal of Medicinal Chemistry (USA),* 33(7): 2015-2019 (Jul 1990).

(R)-(-)- and (S)-(+)-alpha-methyl-beta-4-(fluorophenyl)-N-methyl-N- propynylethylamine (R)-(-)- and (S)-(+)-4-fluorodeprenyl were synthesized via the reaction of 4-fluorobenzaldehyde with nitroethane followed by reduction with lithium aluminum hydride to produce racemic 4-fluoroamphetamine, which was resolved by recrystallization with L- or D-N-acetylleucine to yield (R)-(-)-4-fluoroamphetamine or (S)-(+)-4-fluoroamphetamine in greater than 96% enantiomeric excesses and in yields of 42 and 39%, respectively. Alkylation with propargyl bromide gave (R)-(-)- or (S)-(+)-4-fluorononordeprenyl which was reductively methylated (Borch conditions) to produce (R)-(-)- or (S)-(+)-4-fluorodeprenyl. Alkylation of (R)-(-)- or (S)-(+)-4-fluorononordeprenyl with carbon-11 labeled methyl iodide gave (R)-(-)- or (S)-(+)-[N-11C-methyl]-4-fluorodeprenyl in a radiochemical yield of 30-40%. Comparative PET studies of the two labeled enantiomers in baboons showed a significantly lower retention of radioactivity in the striatum for the (S)-(+) enantiomer relative to the (R)-(-) enantiomer.

5507 Microbiology

Refer also to citation(s) 46364, 46486, 47570, 47624

47686 (PNL-SA-17695) **Biodegradation of nitrogen-containing aromatic compounds in deep subsurface sediments.** Fredrickson, J.K. (Pacific Northwest Lab., Richland, WA (USA)); Brockman, F.J.; Hicks, R.J.; Denovan, B.A. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900171-3: 1. international symposium on microbiology of the deep subsurface, Orlando, FL (USA), 15-18 Jan 1990). Order Number DE90017189. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The aerobic biodegradation of ^{14}C-labeled aniline, quinoline, and pyridine in deep (176 463 m) subsurface sediments obtained from four different boreholes underlying the southeast coastal plain in South Carolina was investigated. Aniline mineralization generally occurred more frequently in the various samples and was more extensively mineralized then quinoline, which in turn was more

readily degraded than pyridine. Biodegradation did not correlate with pH, clay content, or populations of aerobic heterotrophic bacteria. Observations of significant mineralization (>10% released as $^{14}CO_2$) were not consistent between formations, between sediments from the same formation but sampled from different boreholes, or between sediments from the same formation sampled at different depths in the same borehole. These findings indicate considerable vertical and horizontal spatial variability of microbial populations able to metabolize these compounds in deep-subsurface sediments. Relatively deep geological formations of the southeast coastal plain are habitat to diverse microbial populations with the potential to degrade a variety of energy-derived aromatic compounds. 38 refs., 3 figs., 2 tabs.

5508 Morphology

Refer also to citation(s) 47713

5530 Agriculture and Food Technology

Refer also to citation(s) 47617, 47651

47687 (IAEA-R-4947-F) **Development of sexing mechanisms in the Mediterranean fruit fly Ceratitis capitata through manipulation of radiation-induced conditional lethals and other genetic measures: Final report for the period 1 January 1988 - 31 December 1989.** Milani, R. Pavia Univ. (Italy). Dipt. di Biologia Animale; International Atomic Energy Agency, Vienna (Austria). May 1990. 12p. Order Number DE90639722. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The African populations of Ceratitis capitata (Kenya and Reunion Isl.) and two Mediterranean ones (Sardinia and Procida Isl.) have been studied for genetic variability at 25 loci by electrophoresis. Parameters using gene frequencies indicate the presence of substantial geographic heterogeneity. The major part of this heterogeneity is attributable to genetic drift and is correlated with the dispersion of medfly from the source area of the species (Subsaharan Africa) to the periphery. Kenya has all the properties of a native population, as gene flow estimates, in terms of number of immigrant per generation, is significant between Kenya and the derived Mediterranean populations, supporting the hypothesis of a recent colonization. But part of the geographic heterogeneity is related to the presence of fixed alleles in Reunion population which appears particularly differentiated, although it maintains the genetic attributes of the ancestral population. Selection may have played an important role in the differentiation of this population. 12 refs, 2 figs, 2 tabs.

47688 (INIS-mf-12690) **Effect of irradiation and other processing methods on nutritional and technological qualities of foods.** Aurangzeb; Bibi, N.; Ahmad, M.; Sattar, A.; Khan, I. Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan). Jan 1989. 8p. Order Number DE90639724. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

NIFA annual report 1988-89.

The present project was undertaken to investigate the effect of different doses of gamma irradiation on food. The water uptake and cooking behavior of irradiated food after a sufficient time at room temperature was also studied. It was observed that protein contents for fresh vegetable are maximum and minimum for fried vegetables. The nutrient retention in different treatment was calculated and found in the decreasing order of simmering, boiling, roasting and frying. (A.B.).

47689 (PNL-SA-17918-HEDR) **Soil ingestion by dairy cattle.** Darwin, R. Pacific Northwest Lab., Richland, WA (USA). 15 Feb 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. (CONF-9002141--1: Technical steering panel meeting, Richland, WA (USA), 15-16 Feb 1990). Order Number DE90017196. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Ingested soil may be a source of minerals to grazing cattle; it may also be a source of radionuclides, heavy metals, and organic toxins. The importance of soil ingestion in the milk pathway depends on the amount of soil ingested, the ratio of the mineral concentration in soil to that in herbage, and the ability of the cattle to solubilize and absorb the soil-derived minerals. The amount of soil ingested by cattle on pasture, in turn, depends upon the stocking level, the quantity of forage available, and the soil ingesting propensity of individual cows. The objective of this note is to summarize some of the information about soil ingestion by dairy cattle and to suggest methods for incorporating soil ingestion into the Hanford Environmental Dose Reconstruction (HEDR) Phase I milk model. 5 refs., 4 tabs.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 46647, 46668, 46718, 46720, 47713, 47875, 47919, 47921

47690 (AD-A-222240/4/XAB) **Effects of protracted ionizing-radiation dosage on humans and animals: A brief review of selected investigations. Technical report, 5 June 1984-31 January 1985.** Anno, G.H.; Baum, S.J. Pacific-Sierra Research Corp., Los Angeles, CA (USA). 1 Jun 1990. 67p. Contract DNA001-84-C-0289. (PSR-1687). Source: NTIS, PC A04/MF A01.

A review of selected investigations of animal irradiation studies, radiation therapy experience, and radiation accident accounts is presented, and some acute effects of protected ionizing radiation exposure on animals and humans are discussed. Various guidelines and models, which account for biological recovery when radiation exposure is protracted over time, are compared. Biological response modifying effects of dose rate and protraction period in humans are discussed in terms of prodromal symptoms. Radiation injury and recovery in a variety of animals, based on the LD(50) endpoint, are reviewed and summarized for low and high dose rates ranging from 0.5 to about 700 R/h. Biological recovery models and guidelines are empirical and are primarily based on radiation injury accumulation is animals and gauged by the LD(50) endpoint. Further development of appropriate protracted dose models is relevant and necessary for military operations and emergency civil defense planning.

47691 (AD-A-222398/0/XAB) **Chernobyl accident fatalities and causes. Technical report, 29 July 1987-21 December 1988.** Laupa, A.; Anno, G.H. Pacific-Sierra Research Corp., Los Angeles, CA (USA). 1 Jun 1990. 38p. Contract DNA001-87-C-0104. (PSR-1865). Source: NTIS, PC A03/MF A01.

Based on available sources of information, an assessment is made of the Chernobyl accident fatalities and causes of death that resulted from acute injury effects. Accident victims grouped according to whole body radiation dose and biologic response were examined and reconciled based on comparing various sources of information. Fatalities are identified with the occurrence of acute radiation sickness (ARS) syndromes. A maximum likelihood regression analysis was performed on the available fatality and dose data based on five different statistical models to estimate the LD(10), LD(50), and LD(90) values. The estimated LD(50) is about a factor or two higher than previously published values which is attributed to post accident emergency medical and clinical care.

47692 (CNIC-00298) **Selective accumulation of ^{147}Pm in organism on induction of PCE's micronucleus and SCE of bone marrow cells as well as the chromosome aberrations on fetal liver and spleen.** Zhu Shoupeng (Suzhou Medical Coll., JS (China)); Zheng Siying; Wang Liuyi; Lu Zhongyan; Yang Shuqin. China Nuclear Information Centre, Beijing, BJ (China). Jan 1989. 8p. (In Chinese). (SMC-0030). Order Number DE90638228. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Study of accumulation peculiarity of ^{147}Pm showed that I.V. different doses of ^{147}Pm were the same selectively localized in skeleton and liver. Retention of ^{147}Pm in skeleton and liver was elevated when the radioactive doses of ^{147}Pm were increased. At the same time absorption does of ^{147}Pm radiation was heightened. The ability of ^{147}Pm to induce sister chromatid exchanges (SCEs)

has been investigated by IdU labelling methods. A statistically significant elevation of SCEs was observed after ^{147}Pm intake.In mice the number of SCEs per cell in bone marrow cells was always higher when the animals were maintained on the doses of 37 Bq/g. The injurious effects of ^{147}Pm, using PCE's micronucleus rates in bone marrow cells were observed. ^{147}Pm was dominantly deposited on maternal liver. Deposition of ^{147}Pm in maternal spleen was about quandrantal of the maternal liver. Studies indicated that maternal contamination of ^{147}Pm could induced chromosome aberrations in fetal liver and spleen cells. Among the type of aberrations induced by ^{147}Pm, chromatid breakage were predominant. The incidence of chromosome aberrations on fetal liver cells induced by ^{147}Pm was higher on fetal spleen cells.

47693 (DOE/EH–0158T) **Implications of the Biological Effects of Ionizing Radiation (BEIR) V report to the Department of Energy: Final report.** Weadock, A.A. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Health. Aug 1990. 56p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90016673. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

On December 20, 1989, the Secretary of Energy directed the Assistant Secretary for Environment, Safety and Health to undertake a review of the recently released National Research Council report titled Health Effects of Exposure to Low Levels of Ionizing Radiation — BEIR V. This final report represents the Office of Health's response to that directive. The recommendations contained in the final report were approved by the Secretary of Energy on July 30, 1990. The effective implementation of these recommendations should result in continuing reductions in Department of Energy (DOE) collective and individual radiation exposures. The final report includes the results of a survey that was performed to estimate potential cost and engineering impacts that would be associated with a reduction in the occupational radiation dose limits. Although the survey was performed primarily for DOE internal review and decision-making, it is hoped that these cost estimates will prove useful to other organizations concerned with the implementation of radiation protection standards. It should be recognized that the survey results represent rough estimates from the DOE complex; potential sources of error associated with these estimates are described in the final report. 16 refs., 5 figs., 7 tabs.

47694 (IPEN-PUB–152) **Effect of ^{60}Co radiation on peritoneal cells.** Villavicencio, A.L.C.H.; Mastro, N.L. del. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 11p. (In Portuguese). Order Number DE90639690. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This work deals with the effect of ^{60}Co gamma irradiation on the levels and quality of peritoneal cells of albino mice. The cells were obtained from peritoneal exudate, fixed and stained in 30% glacial acetic acid containing 0,5% cristal violet. Os exudates from irradiated and control animals the qualitative analysis and the counting of different cell populations were performed one hour, three days and six days after irradiation with 9 Gy. All the cell populations from the peritoneal exudate shown a decrease 3 days after the irradiation with 9.0. Gy but the different cellular populations dimished in unlike proportions. The data reaffirm the discrepance in radiosensivity of the diverse peritoneal cell populations. (author).

47695 (IPEN-PUB–154) **Molecular exclusion chromatographic analysis on ^{60}Co irradiated rattlesnake.** Murata, Y.; Rogero, J.R. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 7p. (In Portuguese). Order Number DE90639691. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Ionizing radiations are sufficiently energetic to be able of breaking chemical bonds and as result of that molecules of substances present in the irradiated will be chemically changed and their biological properties affected also. In this paper the effects of gamma radiation of Co-60 on the rattlesnake venom were studied. A pool of positive crotamina Crotalus durissus terrificus venom was dissolved in 0,15 M NaCl and irradiated with Co-60. Doses of 100, 250, 500, 750, 1500 and 2000 Gy were applied at the dose rate of 1190 Gy/h. With doses over 500 Gy the solutions became turbid, suggesting the presence of aggregates and structural changes of the proteins. The concentration of proteins from the filtered solution was measured by the Lowry method. One ml samples were measured at 230 nm. The partition coefficients and the areas of the three main fraction obtained were calculated. (author).

47696 (IPEN-PUB–160) **Uptake and loss of Cesium - 134 by the snail Biomphalaria glabrata (Say, 1818).** Kikuchi, O.K.; Mastro, N.L. del. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1988. 8p. (In Portuguese). Order Number DE90639707. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The uptake and loss of Cs-134 produced in IEA-R1 reactor of IPEN was observed in fresh water adult snails. Two activites were employed: 3.700 and 18.500 Bq/1. A monochannel analyses was used for radiactivity couting and the number of egg-laying and embryo were registered. Maximum uptake occured approximately at 8^{th} day and the biological half-life was about 6 days. Although the egg-laying and embryo number were diminished with Cs-134 presence, it is not possible to affirm that result due to the small number of animals used. (author).

47697 (NUREG/CR–2850-Vol.9) **Population dose commitments due to radioactive releases from nuclear power plant sites in 1967: Volume 9.** Baker, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Computer and Telecommunications Services; Pacific Northwest Lab., Richland, WA (USA). Aug 1990. 176p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC06-76RL01830. (PNL–4221-Vol.9). Source: NTIS, PC A09/MF A01 - GPO; OSTI; INIS.

Population radiation dose commitments have been estimated from reported radionuclide releases from commercial power reactors operating during 1967. Fifty-year dose commitments for a one-year exposure from both liquid and atmospheric releases were calculated for four population groups (infant, child, teen-ager and adult) residing between 2 and 80 km from each of 70 reactor sites. This report tabulates the results of these calculations, showing the dose commitments for both water and airborne pathways for each age group and organ. Also included for reach of the sites is a histogram showing the fraction of the total population within 2 to 80 km around each site receiving various average dose commitments from the airborne pathways. The site average individual dose commitment from all pathways ranged from a low of 2×10^{-6} mrem to a high of 0.009 mrem. No attempt was made in this study to determine the maximum dose commitment received by any one individual from the radionuclides released at any of the sites. However, licensee calculation of doses to the maximally exposed individual at some sites indicated values of up to approximately 100 times average individual doses (on the order of a few millirem per year). 2 refs., 2 figs., 7 tabs.

47698 (NUREG/CR–4214-Rev.1-Pt.2 II.5-II.122) **Earl occurring and continuing effects.** Scott, B.R.; Hahn, F.F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Sandia National Labs., Albuquerque, NM (USA). May 1989. (SAND–85-7185-Rev.1-Pt.2). In *Health effects models for nuclear power plant accident consequence analysis. Low LET radiation: Part 2, Scientific bases for health effects models.* Source: NTIS, PC A14/MF A01.

This chapter develops health-risk models for early and continuing effects of exposure to beta or gamma radiation that could be associated with light water nuclear power plant accidents. The main purpose of the chapter is to provide details on each health-risk model and on the data used. Early and continuing effects considered are prodromal symptoms and nonneoplastic diseases that usually occur soon after a brief radiation exposure. These effects are generally associated with relatively high (greater than 1 Gy) absorbed organ doses. For most of the effects considered, there is an absorbed organ dose threshold below which no effects are seen. Some information is provided on health effects observed in victims of the Chernobyl power plant accident. Organs of primary interest, because of their high sensitivity or their potential for receiving large doses, are bone marrow, gastrointestinal tract, thyroid glands, lungs, skin, gonads, and eyes. Exposure of the fetus is also considered. Additional data and modeling techniques available since publication of the Reactor Safety Study were used to obtain models for morbidity and mortality.

47699 (NUREG/CR–4214-Rev.1-Pt.2 II.123-II.186) **Late somatic effects.** Gilbert, E.S. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Sandia National Labs., Albuquerque, NM (USA). May 1989. (SAND–85-7185-Rev.1-Pt.2). In *Health effects models for nuclear power plant accident consequence analysis. Low LET radiation: Part 2, Scientific bases for health effects models.* Source: NTIS, PC A14/MF A01.

Late effects are by definition effects that occur at least one year, and in most cases decades, after the time of exposure. The late effects considered in this chapter are limited to latent cancer incidence and mortality, and benign thyroid disease. A model is provided for estimating risks of late effects resulting from the radiation exposure likely to be received in the event of a nuclear power plant accident. It is assumed that exposure to high-LET radiation would be negligible in such an accident, and thus only risks from low-LET exposure are evaluated. Separate estimates are provided for risks of leukemia, bone cancer, lung cancer, gastrointestinal cancers, thyroid cancer, skin cancer, and the residual group of all other cancers; estimates of leukemia and other cancers due to in utero exposure are also provided. Risks are expressed in absolute terms as the number of cancer deaths (or cases) per million persons exposed to a particular dose. Because the time of death is also important in assessing the impact of an accident, and because the quality of life after the occurrence of cancer will often be reduced, the number of years of life lost and the number of years of life lived after the occurrence of cancer are also estimated.

47700 (NUREG/CR–4214-Rev.1-Pt.2 II.187-II.291) **Genetic effects.** Bender, M.A. (Brookhaven National Laboratory, Upton, NY (USA)); Abrahamson, S.; Denniston, C.; Schull, W.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Sandia National Labs., Albuquerque, NM (USA). May 1989. (SAND–85-7185-Rev.1-Pt.2). In *Health effects models for nuclear power plant accident consequence analysis. Low LET radiation: Part 2, Scientific bases for health effects models.* Source: NTIS, PC A14/MF A01.

In this chapter, we present a comprehensive analysis of the major classes of genetic diseases that would be increased as a result of an increased gonadal radiation exposure to a human population. The risk analysis takes on two major forms: the increase in genetic disease that would be observed in the immediate offspring of the exposed population, and the subsequent transmission of the newly induced mutations through future generations. The major classes of genetic disease will be induced at different frequencies, and will also impact differentially in terms of survivability and fertility on the affected individuals and their descendants. Some classes of disease will be expected to persist for only a few generations at most. Other types of genetic disease will persist through a longer period. The classes of genetic diseases studied are: dominant gene mutation, X-linked gene mutation, chromosome disorders and multifactorial disorders which involve the interaction of many mutant genes and environmental factors. For each of these classes we have derived the general equations of mutation induction for the male and female germ cells of critical importance in the mutation process. The frequency of induced mutations will be determined initially by the dose received, the type of radiation and, to some extent at high dose, by the manner in which the dose is received. We have used the modeling analyses to predict the outcomes for two nuclear power plant accident scenarios, the first in which the population receives a chronic dose of 0.1 Gy (10 rad) over a 50-year period, the second in which an equivalent population receives an acute dose of 2 Gy. In both cases the analyses are projected over a period of five generations.

47701 (PB–90-246984/XAB) **Induction and repair of double-strand DNA breaks in mammalian cells detected by neutral elution.** van der Schans, G.P. Gezondheidsorganisatie TNO, Rijswijk (Netherlands). Medisch Biologisch Lab. 17 Nov 1989. 27p. (MBL–1989-12). Source: NTIS, PC A03/MF A01.

Summary in Dutch.

One of the important types of damage induced by ionizing radiation in intracellular DNA is the double-strand break (dsb). This damage, involving disruption of both strands of the DNA-helix at the same or neighboring sites, is produced at a much lower frequency than other lesions (single-strand breaks, nucleotide damage). One would expect, however, that double-strand breaks would be much more deleterious for the cell than lesions of the latter type as these probably are repaired more easily. The neutral filter elution technique has proven to be a sensitive means of detecting DNA dsb after exposure to low doses of ionizing radiation. However, the results obtained with it reported in literature are in some cases controversial as well as in disagreement with results of other methods. In the report the reliability of the different methods for the detection of dsb induced by ionizing radiation and other agents are discussed.

47702 (PNL–7136) **Multimedia Environmental Pollutant Assessment System (MEPAS) application guidance: Getting started with MEPAS.** Buck, J.W.; Hoopes, B.L.; Friedrichs, D.R. Pacific Northwest Lab., Richland, WA (USA). Dec 1989. 56p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Source: National Energy Software Center (software packages requested by U.S. Government Agencies and Their Contractors), Argonne National Laboratory, Argonne, IL (312-972-7250 or FTS 972-7250). Other requestors should be directed to PNL.

The Multimedia Environmental Pollutant Assessment System (MEPAS) was developed by Pacific Northwest Laboratory for the US Department of Energy Office of Environment, Safety and Health. MEPAS is used to prioritize hazardous, radioactive, and mixed-waste sites, based on their potential hazard to public health. It is applicable to a wide range of environmental management and regulatory conditions. MEPAS employs a computer-assisted, simplified, contaminant-transport and exposure model. It incorporates an interactive shell program to assist the user in problem definition, data assembly and input, and report development. This manual is an introduction to MEPAS. It provides brief instructions for installing and running the computer programs and data bases on a desk-top personal computer. Detailed instructions for data entry and evaluation are provided in the MEPAS User's Guide. 26 figs.

47703 (PNL–7438) **Dissolution and particle size characterization of radioactive contaminants in Hanford facilities: Criteria for methods of measurement.** Briant, J.K.; James, A.C. Pacific Northwest Lab., Richland, WA (USA). Aug 1990. 61p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE90015972. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The purpose of this document is to discuss experimental methods that can be applied to evaluate the rate at which an actinide material is likely to dissolve in biological fluids. Criteria are recommended for the design and conduct of meaningful experimental procedures to sample a representative size fraction of the source material, to measure the rate of radionuclide dissolution, and to apply the results to assign the material to an appropriate ICRP Publication-30 lung retention class (or mixture of classes). 26 refs., 3 figs., 3 tabs.

47704 (PNL-SA–17594) **Overview of ICRP respiratory tract model.** Bair, W.J. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900733–1: 3. international workshop on respiratory tract dosimetry, Albuquerque, NM (USA), 1-3 Jul 1990). Order Number DE90016536. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The International Commission On Radiological Protection (ICRP) is currently undertaking a number of efforts leading to a revision of its basic recommendations on radiation protection. These efforts include reviews and reassessment of its system of dose limitation as well as the values of primary limits. ICRP Committee 2 is preparing for a possible revision of secondary limits, which will include the annual limits on intake (ALI). To support this work, a task group on human respiratory dosimetric models was appointed to review the current lung dosimetry model and, if needed, propose a revised model. The purpose of a dosimetric model of the human respiratory tract is to provide a qualitative and quantitative understanding of the respiratory tract as a route for the entry of radionuclides into the body. This is a fundamental requirement for calculating dose equivalents for respiratory tract tissues using information about exposures to airborne radionuclides or from bioassay data. A model

that includes a description of the clearance of deposited radionuclides from the respiratory tract and transfer to circulating blood is also necessary to calculate dose equivalents to other body organs and tissues in which the radionuclides may be deposited. 2 refs., 2 figs., 2 tabs.

47705 (PNL-SA–17741) **Calculation of dose and hit probability to cells irradiated in vitro by alpha particles.** Hui, T.E.; Brooks, A.L.; Fisher, D.R.; James, A.C.; Jostes, R.F. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830 ;AM06-70RL02225. (CONF-900679–8: 1990 Health Physics Society meeting, Anaheim, CA (USA), 24-28 Jun 1990). Order Number DE90017195. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A method using principles of microdosimetry was developed for calculating the dose and hit probability to cells and cell nuclei irradiated in vitro by alpha particles. Three different geometries are currently used to irradiate cells: a mixture of cells and alpha-emitting sources in a culture medium, a gas-flow system with cells growing on a thin Mylar layer over a gaseous alpha source, and a planar alpha disc source beneath a thin Mylar layer on which cells are grown in a nutrient medium. Based on the experimental design, the source-target geometry of the alpha source distribution relative to the cells or cell nuclei can be established as a frequency distribution of particle track lengths. We then calculate, in addition to the absorbed dose (mean specific energy), the probability density in specific energy, and the probabilities that cells or nuclei are missed, hit once, hit twice,···, or hit n times, and the average number of alpha hits to the targets. This additional dosimetric information improves our interpretation of experimental data. An example of applying microdosimetry to analyze micronuclei induction by alpha particles is presented. This approach to alpha-particle microdosimetry is adaptable to any experimental design for in vitro cell irradiation by radon and daughters or other alpha sources. 4 figs., 5 tabs.

47706 (PNL-SA–18380) **Recent Pacific Northwest Laboratory beagle and rodent studies: Methods and results.** Gilbert, E.S.; Park, J.F.; Cross, F.C.; Dagle, G.E. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007165–1: American statistical association (ASA) conference on radiation and health, Copper Mountain, CO (USA), 8-13 Jul 1990). Order Number DE90017140. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Analyses based on data from two experimental studies conducted at Pacific Northwest Laboratory will be presented. The first is a lifespan study of beagle dogs exposed to inhaled plutonium. The objectives of this study are, first, to determine the biological effects in dogs of inhaled plutonium at various dose levels, and, second, to obtain dose-effect relationship data that can be used to estimate the risk of these effects in humans. In this study, eighteen-month-old beagle dogs were exposed through inhalation to six different levels and three different types of plutonium. The lowest level corresponds to the maximum permissible level for a plutonium worker, while the highest level is a level at which radiation pneumonitis is likely to cause early death. $^{239}PuO_2$ was chosen because it is the form of plutonium to which people working in nuclear fuel processing and storage industries are likely to be exposed. $^{238}PuO_2$ and $^{239}Pu(NO_3)_4$ were chosen because they result in different spatial and temporal distribution of radiation dose, and thus can provide information on the influence of these factors on risk. The second experiment is a lifespan study of rodents exposed through inhalation to radon and radon progeny. For the rodent experiments to be considered in this presentation, exposures were initiated at about 90 days of age at rates of 5, 50, and 500 WLM per week. Cumulative exposure levels were 320, 640, 1280, 2560, and 5120 WLM for animals exposed at 50 and 500 WLM per week, and 320 WLM for animals exposed at 5 WLM per week. 7 refs.

47707 (PNL-SA–18391) **Statistical methods for analyzing and combining data on low-level exposures to ionizing radiation.** Gilbert, E.S. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007165–2: American statistical association (ASA) conference on radiation and health, Copper Mountain, CO (USA), 8-13 Jul 1990). Order Number DE90017193. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Occupational studies of workers who have been exposed to radiation provide a direct assessment of low-level radiation risks, and can serve as a check on estimates obtained through extrapolation from studies of populations exposed at high levels. Several studies of workers involved in the production of both defense materials and nuclear power in the United States, Great Britain, and Canada are being conducted. If our current risk estimates are correct, these studies have very low power for detecting risks, but can be used to provide useful upper limits on risks. If our current risk estimates are too low, the studies are adequate to detect large departures from these estimates. A broad assessment based on the totality of evidence from all occupational studies is obviously desirable, and such an assessment can be best accomplished by analyzing combined data from all studies. Plans for international combined analyses are underway, and combined analyses on a national scale are also being conducted. In the US, results based on combined data on male workers at the Hanford Site, Oak Ridge National Laboratory (ORNL), and Rocky Flats Weapons Plant have been published, and are used in this presentation to illustrate the application of various statistical procedures. 6 refs.

47708 **New approaches for biological monitoring of radiation workers.** Mendelsohn, M.L. (Lawrence Livermore National Laboratory, CA (USA)). *Health Physics (USA),* 59(1): 23-28 (Jul 1990).

Methods for measuring somatic mutation and chromosome aberration in humans are currently advancing and provide important new opportunities for biologic dosimetry of nuclear workers. Methods to test somatic mutation in four human genes (hprt, hla-a, glycophorin A, and beta globin) are reviewed briefly and evaluated for their applicability to biological radiation dosimetry of nuclear workers. Two somatic mutation tests can be currently recommended: an HPRT method applied to recently exposed workers and the glycophorin A method applied to workers exposed over their working lifetime. A new method of chromosome analysis using DNA hybridization with chromosome-specific gene libraries allows one to paint single or multiple chromosome pairs in standard metaphase preparations. This method is ideal for rapid and reliable detection of reciprocal translocations, the key lesion for the evaluation of long-term radiation exposure. Both mutational and aberrational approaches should be fostered in the expectation that they will complement other forms of dosimetry and will improve our ability to clarify whether or not significant health effects are dosimetrically related.

47709 **Gene expression and hormone autonomy in radiation-induced tumors of Arabidopsis thaliana.** Persinger, S.M. (Case Western Reserve Univ., Cleveland, OH (USA)); Town, C.D. *Plant Physiology, Supplement (USA),* 89(4): 47 (Apr 1989).

In order to study the molecular genetics of factor controlling plant cell growth, we have isolated a group of radiation-induced tumors from Arabidopsis thaliana. Tumors appeared on plants derived from ^{60}Co gamma-irradiated seed or seedlings, and are capable of hormone-autonomous growth in culture. We have used vertebrate oncogene probes to explore the hypothesis that the tumors arose by the radiation-induced activation of growth-regulating plant oncogenes. One probe, int-2, was used to isolate cDNA clones representing an mRNA differentially expressed between tumors and hormone-dependent callus tissue. The genomic organization and function of this and other differentially expressed Arabidopsis sequences are being further characterized. A second area of study concerns the hormonal status of individual tumors. Tumor tissue varies in color, texture, and degree of differentiation: while some tumors appear undifferentiated, one consistently produces roots, and others occasionally develop shoots or leaflets. The tumors have characteristic growth rates on hormone-free medium, and growth in response to exogenous hormones differs among the tumors themselves and from wild-type. Characterization of the relationships between hormonal status, morphogenesis, and gene expression should yield valuable insights into the mechanisms regulating plant growth and development.

47710 **Improved ultrasonic measurement techniques applied to assay of Pu and other transuranics in lung.** Kruchten,

D.A. (Lawrence Livermore National Lab., CA (USA)); Anderson, A.L. *Health Physics (USA)*, 59(1): 117-123 (Jul 1990).

At the Lawrence Livermore National Laboratory, we are developing a system that will more accurately measure fat, muscle, and bone content from ultrasonic images of the chest wall. This paper describes a procedure that will allow chest-wall thickness to be determined to within +/- 1.5 mm (compared with the +/- 3-6 mm from current techniques) and may allow absolute errors in chest-wall composition to be reduced to +/- 4%.

47711 **Hormonal relations of radiation-induced tumors of Arabidopsis thaliana.** Campell, B.R. (Case Western Reserve Univ., Cleveland, OH (USA)); Persinger, S.M.; Town, C.D. *Plant Physiology, Supplement (USA)*, 89(4): 109 (Apr 1989).

When gamma-irradiated Arabidopsis seed was germinated, tumors appeared on hypocotyls and apical meristems of the resulting plants. Several tumors have been cultured on hormone free medium for over two years since excision from the plants. The tumor lines display a range of phenotypes suggestive of abnormal hormone balance. To determine whether hormone overproduction or hypersensitivity is involved in tumorigenesis, we are measuring hormone levels in the tumor lines and characterizing their response to exogenously supplied growth regulators. Growth of two tumor lines is stimulated by either NAA or BAP, one is stimulated by NAA only, two by BAP only, and one is stimulated by neither. Growth of all lines tested thus far is inhibited by gibberellic acid, ethephon and ACC. The tumor lines appear more sensitive to ACC than normal callus tissue. Most tumors studied to date appear unlikely to have arisen due to increased hormone sensitivity. Experiments are in progress to determine auxin and cytokinin levels in the tumor lines.

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Refer also to citation(s) 46395, 46479, 46602, 46607, 46608, 46610, 46611, 46718, 46721, 46751, 47513, 47531, 47551, 47553, 47554, 47555, 47558, 47574, 47575, 47576, 47577, 47579, 47580, 47581, 47582, 47583, 47584, 47586, 47587, 47588, 47589, 47590, 47591, 47592, 47593, 47594, 47595, 47596, 47601, 47602, 47603, 47604, 47606, 47607, 47608, 47609, 47610, 47611, 47612, 47613, 47614, 47620, 47702

47712 (AD-A-222018/4/XAB) **Acute, delayed neurotoxicity evaluation of two jet-engine-oil formulations. Final report, May-October 1989.** Kinkead, E.R.; Bunger, S.R.; Wolfe, R.E.; Wall, H.G. NSI Technology Services Corp., Dayton, OH (USA). Apr 1990. 25p. Contract F33615-85-C-0532. Source: NTIS, PC A03/MF A01.

This study was designed to determine the potential of two jet oils to produce acute, delayed neurotoxicity. The hydrocarbon-based ester oil formulation contained 3% tricresyl phosphate isomers, including triorthocresyl phosphate (TOCP) in one of the formulations. Hens were orally dosed over a five-day period and then observed for a total period of 30 days. All TOCP-positive control hens demonstrated signs of acute, delayed neurotoxicity. Hens from both jet engine oil groups remained asymptomatic throughout the observation period. No neurotoxic hazard would be expected for military or civilian personnel involved in the manufacture, transportation, or handling of these compounds.

47713 (DOE/ER/60656-3) **Cellular morphometry of the bronchi of human and dog lungs: Annual progress report, January 1, 1990-December 31, 1990.** Robbins, E.S. New York Univ., NY (USA). Dept. of Cell Biology. Sep 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER60656. Order Number DE90017512. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One hundred and twenty one bronchial samples from 58 patients (54 useable; 32 female, 22 male; median age 61) have been dissected by generation from fixed surgical lung specimens obtained after the removal of pathological lesions. Complete patient records including occupational and smoking histories, as well as possible exposure to radon, are being kept. In addition, mongol dog bronchi dissected from different lobes of 23 dog lungs have been used to establish protocols. Ninety human samples have been completely processed for electron microscopy and have yielded 913 electron micrographs of which 471 have been entered into the Computerized Stereological Analysis System (COSAS) and used for the measurement of the distances of basal and mucous cell nuclei to the epithelial free surface. We have, using the COSAS planimetry program, established a small data base which describes the volume density and nuclear numbers per electron micrograph for 5 cell types of the human bronchial epithelial lining of men and women, as well as smokers, nonsmokers and ex-smokers. The data is being used to develop weighting factors for dosimetry and radon risk analysis. The electron micrographs of dog bronchial epithelium are unanalyzed as yet. 4 figs., 2 tabs.

47714 (ORNL/FTR-3717) **[Pesticide chemistry]: Foreign trip report, August 6, 1990-August 23, 1990.** Barnthouse, L.W. Oak Ridge National Lab., TN (USA). 4 Sep 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90017501. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report summarizes a trip by L. W. Barnthouse of the Environmental Sciences Division (ESD), Oak Ridge National Laboratory (ORNL), to Hamburg, Federal Republic of Germany (FRG), where he participated in the 7th International Congress of Pesticide Chemistry. He chaired a workshop on experimental systems for determining effects of pesticides on nontarget organisms and gave an oral presentation at a symposium on pesticide risk assessment. Before returning to the United States, Dr. Barnthouse visited the Netherlands Institute for Sea Research in Texel, the Netherlands.

47715 (PB-90-215294/XAB) **Drinking-water criteria document for 2,3,7,8-tetrachlorodibenzo-p-dioxin. Draft report.** Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment. Apr 1988. 363p. (ECAO-CIN-405). Source: NTIS, PC A16/MF A02.

See also PB-86-117983.

2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is one of the most toxic and environmentally stable tricyclic aromatic compounds belonging to chlorinated dibenzo-p-dioxins. 2,3,7,8-TCDD has been demonstrated to be teratogenic in rats, mice and rabbits, and feticidal in monkeys. The major toxic signs and terata observed were cleft palate in mice, edema, hemorrhage, and kidney anomalies in rats and extra ribs in rabbits. Some epidemiological studies have indicated a possible teratogenic effect in humans, but the evidence is not sufficient to reach a firm conclusion.

47716 (PB-90-215443/XAB) **Quantification of toxicological effects for dichloromethane. Draft report (Final).** Dynamac Corp., Rockville, MD (USA). Apr 1990. 46p. Source: NTIS, PC A03/MF A01.

The source documents for background information used to develop the report on the quantification of toxicological effects for dichloromethane are the health assessment document (HAD) for dichloromethane and a subsequent addendum to the HAD (U.S. EPA, 1985b). In addition, some references published since 1985 are discussed. To summarize the results of the quantification of toxicological effects, a One-day Health Advisory of 10,000 ug/L for a 10-kg child was calculated, based on an acute oral study in rats reported by Kimura et al. (1971). No suitable data for the derivation of a Ten-day Health Advisory were found in the available literature.

47717 (PB-90-242363/XAB) **Risk from exposure to polychlorinated dibenzo-p-dioxins and dibenzofurans emitted from municipal incinerators.** Maukerjee, D.; Cleverly, D.H. Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment. ©1987. 17p. (EPA-600/J-87/516). Source: NTIS, PC A03/MF A01.

Pub. in Waste Management and Research 5, 269-283(1987).

Incineration of wastes seems to be one of the major sources of PCDDs and PCDFs (dioxins). Their prevalence and extreme stability in the environment, bioavailability and bioaccumulation in the biota and human adipose tissues and breast milk are of much concern. 2,3,7,8-TCDD is one of the most toxic chemicals known and has been found to have teratogenic and carcinogenic activities in animals. Exposure to TCDD can result in chloracne, general weakness, drastic weight loss, hyperpigmentation of skin, hirsutism, porphyria cutanea tarda, liver damage, changes in activities of

various liver enzymatic levels, abnormal lipid metabolism, abnormalities of the endocrine and immune systems, and possible teratogenic effects in humans. Moreover, chronic bioassay data indicate that TCDD is one of the most potent carcinogens known. It promotes liver and skin carcinogeneses, and is an initiator for various target organs in rodent test systems. According to the classification system of IARC, the qualitative evidence for carcinogenicity of TCDD is considered to be sufficient in animals and inadequate in humans. Consequently, TCDD has been placed in IARC's 2B category. In the absence of chronic bioassay data on other PCDDs and PCDFs, several TCDD equivalent approaches have been proposed for risk assessment on other congeners or mixtures. The paper compares the various approaches.

47718 (PB–90-245465/XAB) **Pulmonary effects due to subchronic exposure to oil fog.** Selgrade, M.K.; Hatch, G.E.; Grose, E.C.; Stead, A.G.; Miller, F.J. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1990. 23p. (EPA–600/J-90/080). Source: NTIS, PC A03/MF A01.

Pub. in Jnl. Toxicology Environmental Health, Vol. 6, No. 1, 123-143(Jan 199)0. See also PB–88-139639.

Male rats were exposed to an oil fog generated by flash vaporization and subsequent condensation of lightweight lubricating oil. Exposures were for 3.5 h/d, 4d/wk for 13 wk, at concentrations of 1.5, 0.5, 0.2 or 0.0 mg/l (1500, 500, 200, and 0 mg/cu m) and a particle size of approximately 1 micro m (mass median aerodynamic diameter). A number of biologic endpoints were assessed the day after the last exposure and, in some cases, after a 4 wk recovery period. Effects of 1.5 mg/l on male and female rats were compared. Diffuse accumulation of macrophages in the alveoli was observed in all oil fog exposed groups. The degree of severity was concentration dependent. Histopathologic changes were more prominent in males than in females and represented the most notable gender-related differences. Histologic effects observed one day and 4 wk post exposure were similar. Minimal histopathologic changes and minimal increase in lavage fluid protein were the only effects observed at the 0.2 mg/l exposure level. There was a significant increase in lavage fluid protein, percent lavagable polymorphonuclear leukocytes and lung wet and dry weight following exposure to both 0.5 and 1.5 mg/l.

47719 (PB–90-245770/XAB) **Using the DNA alkaline unwinding assay to detect DNA damage in laboratory and environmentally exposed cells and tissues.** Nacci, D.; Jackim, E. Science Applications International Corp., Narragansett, RI (USA). ©1990. 6p. Source: NTIS, PC A02/MF A01.

Pub. in Marine Environmental Research 28, 333-337(1989).

The DNA alkaline unwinding assay is being evaluated for use in the detection of DNA damage in marine animals exposed to environmental pollutants. In preliminary work, DNA unwinding methods were used with in vitro cell systems to demonstrate DNA strand breaks. Cultured mammalian fibroblasts and sperm from marine fish and invertebrates (Pseudopleuronectes, Arbacia and Mytilus) showed concentration-dependent increases in DNA strand breaks after brief exposures to alkylating agents. DNA unwinding methods were also used on DNA extracted from marine animals injected with genotoxicants and from animals exposed in situ at an estuarine site. Gills from blue mussels caged at the New Bedford Harbor Superfund Site (MA, USA) highly contaminated with many organic (e.g. PCBs) and inorganic contaminants, were also examined. A significant increase in DNA strand breaks was seen in gill tissues of animals held in the contaminated site for as little as 3 days. Although not as severe, an increase in strand breaks was also seen in animals held at the control site for 28 days.

47720 (PB–90-245788/XAB) **Half-life of polychlorinated biphenyls in occupationally exposed workers.** Phillips, D.L.; Smith, A.B.; Burse, V.W.; Steele, G.K.; Needham, L.L. Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. ©1989. 6p. (EPA–600/J-89/416). Source: NTIS, PC A02/MF A01.

Pub. in Archives of Environmental Health, Vol. 44, No. 6 (Nov/Dec 1989).

In 1977 and 1985, serum polychlorinated biphenyl (PCB) concentrations were determined for 58 workers in a Bloomington, Indiana, factory that used PCBs in capacitor manufacture until 1977. Less chlorinated PCBs were quantitated as Aroclor 1242, and more highly chlorinated PCBsw were quantitated as Aroclor 1254. The median half-life was 2.6 y for Aroclor 1242 and 4.8 y for Aroclor 1254. However, the half-life varied inversely with the initial serum concentration. This pattern may be a result of continued low-level exposure, variation in the time of exposure, or enzyme induction by PCBs.

47721 (PB–90-245838/XAB) **Use of a spectroradiometer to study aerial photographs of ozone-treated soybeans.** Edwards, G.J.; Cure, W.W. Citrus Research and Education Center, Lake Alfred, FL (USA). ©1989. 8p. Source: NTIS, PC A02/MF A01.

Pub. in International Jnl. of Remote Sensing, Vol. 10, No. 12, 1913-1918(1989).

A scanning spectroradiometer was used to measure the optical densities of an aerial photograph of an experimental field in which soybeans were growing in response to different concentrations of ozone, an air pollutant. The plants were growing in 3 m diameter, 2.4 m high open-top exposure chambers. Correlation coefficients among the film densities, plant yield and visual estimates of nongreen leaf area for the 16 test plots were highly significant ($p<0.0$); those with ozone treatment concentrations were significant ($p<0.05$). The early senescence induced by this form of environmental stress can thus be detected by film density differences, and these differences are well correlated with ground indicators of crop condition.

47722 (PB–90-245879/XAB) **Inhalation reference dose (RfDI): An application of interspecies dosimetry modeling for risk assessment of insoluble particles.** Jarabek, A.M.; Menache, M.G.; Overton, H.; Dourson, M.L.; Miller, F.J. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1989. 9p. (EPA–600/J-89/408). Source: NTIS, PC A02/MF A01.

Pub. in Health Physics, Vol. 57, Supl. 177-183(Jul 1989).

Accurate extrapolation of animal toxicity data for human health risk assessment requires determination of the effective dose to the target tissue and the sensitivity of the target tissue to that dose. The methodology for deriving reference doses (the U.S. Environmental Protection Agency's (EPA) benchmark values for gauging systemic toxicity) for oral exposures has not included dosimetry modeling. Dosimetry data facilitate evaluation of concentration-response data with respect to the dose-response relationships used in quantitative risk assessment. Extension of the methodology to derivation of inhalation reference doses (RfDi) should account for the dynamics of the respiratory system as the portal of entry. The paper presents a method for calculating a dosimetric adjustment factor based on the values for the initial deposited dose of insoluble particles in an animal species and in humans. The application for insoluble particles illustrates the feasibility of interspecies dosimetry calculations for extrapolating the toxicological results of inhaled agents to human exposure conditions for more accurate risk estimation.

47723 (PB–90-245945/XAB) **Effects of depletion of ascorbic acid or nonprotein sulfhydryls on the acute inhalation toxicity of nitrogen dioxide, ozone, and phosgene.** Slade, R.; Highfill, J.W.; Hatch, G.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1989. 12p. (EPA–600/J-89/400). Source: NTIS, PC A03/MF A01.

Pub. in Inhalation Toxicology, Vol. 1, No. 3, 261-271(Jul 1989).

The effect of depleting lung ascorbic acid (AH_2) and nonprctein sulfhydryls (NPSH) on the acute inhalation toxicity of nitrogen dioxide (NO_2), ozone (O_3), and phosgene ($COCl_2$) was investigated in guinea pigs. The increase in bronchoalveolar lavage (BAL) fluid protein (an indicator of alveolar-capillary damage leading to increased permeability) was measured 16 to 18 hr following a 4 hr exposure to the gas in animals deficient in (AH_2) or NPSH. Gas concentrations were chosen which produced low but significant increases in BAL protein. Lung (AH_2) was lowered to about 20% of control by feeding rabbit chow for 2 weeks. Lung NPSH was lowered to about 50% of control by injecting a mixture of buthionine S,R-sulfoximine (BSO) and diethylmaleate (DEM) (2.7 and 1.2 mmol/kg respectively). BSO/DEM did not affect the lung concentrations of (AH_2) or alpha-tocopherol. AH_2 depletion caused a 6 fold and a 3 fold enhancement in the toxicity of 5 ppm and 10 ppm (NO_2), and a 6 fold enhancement in the toxicity of 0.5 ppm (O_3),

but did not affect toxicity of 1.0 ppm (O_3). AH_2 depletion did not affect phosgene toxicity (at 0.25 ppm and 0.5 ppm).

47724 (PB–90-245952/XAB) **Cancer mortality in US counties with hazardous-waste sites and ground-water pollution.** Griffith, J.; Duncan, R.C.; Riggan, W.R.; Pellom, A.C. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1989. 9p. (EPA–600/J-89/399). Source: NTIS, PC A02/MF A01.

Pub. in Archives of Environmental Health, Vol. 44, No. 2, 69-74(Apr 1989).

Since the late 1950's more than 750 million tons of toxic chemical wastes have been discarded in an estimated 30,000 to 50,000 hazardous waste sites (HWS). The uncontrolled discarding of chemical wastes creates the potential for risks to human health. Utilizing the National Priorities Listing (NPL) of hazardous waste sites developed by the U.S. Environmental Protection Agency (EPA), the study identified 593 waste sites in 339 U.S. counties in 49 states with analytical evidence of contaminated ground drinking water providing a sole source water supply to an estimated at risk population. For each of the 339 identified counties the authors extracted age-adjusted, site-specific cancer mortality rates for 12 major sites for the decade 1970-1979, for white males and females, from U.S. Cancer Mortality and Trends 1950-1979. Each county in the U.S. was also coded as to whether it had an excessively high number of deaths and the total number of non-HWS and HWS counties showing excess numbers of deaths were enumerated for each selected cancer. Significant associations ($p < 0.002$) between excess deaths and all HWS counties were shown for cancers of the lung, bladder, esophagus, stomach, large intestine, and rectum for white males; and for cancers of the lung, breast, bladder, stomach, large intestine, and rectum for white females when compared to all non-HWS counties.

47725 (PB–90-245978/XAB) **Biochemical effects of three carcinogenic chlorinated methanes in rat liver.** Kitchin, K.T.; Brown, J.L. Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab. ©1989. 10p. (EPA–600/J-89/397). Source: NTIS, PC A02/MF A01.

Pub. in Teratogenesis, Carcinogenesis, and Mutagenesis, Vol. 9, 61-69(Jan 1989).

Three chlorinated methanes, carbon tetrachloride, chloroform and methylene chloride known to cause liver tumors in rodents, were given by oral gavage to adult female rats both 21 and 4 hours before sacrifice. Then hepatic DNA damage, ornithine decarboxylase, cytochrome P-450, glutathione content and serum alanine aminotransferase activity assays were performed. Carbon tetrachloride increased rat hepatic ornithine decarboxylase activity and decreased cytochrome P-450 content at doses both below and above cytotoxicity (as measured by increased serum alanine aminotransferase activity). At 54 and 160 mg/kg, chloroform increased hepatic ornithine decarboxylase activity with minimal or no elevation in serum alanine aminotransferase activity. After oral administration of 480 mg/kg of chloroform, hepatic ornithine decarboxylase activity, serum alanine aminotransferase activity and hepatic DNA damage were increased while hepatic cytochrome P-450 content was decreased. The results with methylene chloride varied between replicates done on three different days.

47726 (PB–90-246018/XAB) **Immunosuppression of pulmonary natural killer activity by exposure to ozone.** Burleson, G.R.; Keyes, L.L.; Stutzman, J.D. Northrop Services, Inc., Research Triangle Park, NC (USA). ©1989. 22p. Source: NTIS, PC A03/MF A01.

Pub. in Immunopharmacology and Immunotoxicology, Vol. 11, No. 4, 715-735(Dec 1989).

Ozone is an oxidant gas and an ubiquitous oxidant air pollutant with the potential to adversely affect pulmonary immune function with a subsequent increase in disease susceptibility. Pulmonary natural killer (NK) activity was measured in order to assess the pulmonary immunotoxicity of continuous ozone exposure. Continuous ozone exposures at 1.0 ppm were performed for 23.5 hours per day for either 1, 5, 7, or 10 consecutive days. Pulmonary immune function was assessed by measuring NK activity from whole-lung homogenate of male Fischer-344 rats. Results of the study indicated that continuous ozone exposure for 1, 5, or 7 days resulted in a significant decrease in pulmonary NK activity. This suppressed pulmonary NK activity returned to control levels after continuous exposure to ozone for 10 days. This adaption, or attenuation process, is complex and poorly understood. Pulmonary NK activity was also suppressed at 0.5 ppm ozone, but not at 0.1 ppm ozone, for 23.5 hours. NK activity is important for defense against viral, bacterial, and neoplastic disease.

47727 (UCRL-CR–103401) **Chlorine dioxide and hemodialysis.** Smith, R.P. (Dartmouth Coll., Hanover, NH (USA). Dept. of Pharmacology and Toxicology). Lawrence Livermore National Lab., CA (USA); Dartmouth Coll., Hanover, NH (USA). Dept. of Pharmacology and Toxicology. 1 May 1989. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015912. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Because it has little or no tendency to generate carcinogenic trihalomethanes such as chloroform, chlorine dioxide is an attractive alternative to chlorine for drinking water disinfection. There are, however, concerns about its acute toxicity, and the toxic effects of its by-products, chlorite and chlorate. The human experience with chlorine dioxide in both controlled, prospective studies and in actual use situations in community water supplies have as yet failed to reveal adverse health effects. The EPA has recommended standards of 0.06 mg/L for chlorine dioxide and standards of 0.007 mg/L for chlorite and chlorate in drinking water. Among groups who may be at special risk from oxychlorines in drinking water are patients who must undergro chronic extracorporeal hemodialysis. Although even units for home hemodialysis are supposed to be equipped with devices which effectively remove oxychlorines, there is a always a possibility of operator error or equipment failure. When the equipment is adequately maintained, it is likely that dialysis patients will have more intensive exposures from drinking water than from dialysis fluids despite the much larger volumes of water that are involved in dialysis. This paper discusses a hemodialysis and the standards and effects of oxychlorines. 90 refs., 2 tabs.

47728 **Foliar uptake of nitrogen oxides: A nitrogen source for forests?.** Hanson, P.J. (Oak Ridge National Laboratory, TN (USA)); Taylor, G.E. Jr.; Gunderson, C.A. *Plant Physiology, Supplement (USA)*, 89(4): 14 (Apr 1989).

Non-urban concentrations of nitrogen oxide gases are insufficient to directly impede plant growth processes, but foliar uptake of these gases may represent a significant N source. Measurements of NO_2 and HNO_3 vapor uptake by elements representative of a forest landscape (e.g. foliage, bark, forest floor) were conducted in an open gas exchange system. Under daylight conditions using a mean NO_2 level of 33 ml l^{-1}, NO_2 uptake by foliage of forest tree species ranged from 0.35 to 5.75 nmol m^{-2} s^{-1}. Uptake of NO_2 by broadleaf species was greater than by conifers. Dry bark surfaces showed about half the conductance to NO_2 than did plant shoots. Forest floor samples had a disproportionately high conductance to NO_2 when compared to bark or foliage surfaces. At similar concentrations, uptake of HNO_3 vapor exceeded that for NO_2. Foliar NO_2 uptake, under stomatal control, was principally to leaf interiors, but HNO_3 uptake occurred to leaf interiors and surfaces. Based on ambient NO_2 concentrations and conductance data scaled to the forest canopy, NO_2 deposition provides from 0.1 to 2.0 kg ha^{-1} y^{-1} of nitrogen to natural forests (0.1 to 3% of annual needs). Conversely, deposition to urban forests may supply >10% of a forest's annual need.

47729 **Annual pattern of nitrate reductase activity in needles of high-elevation red spruce trees.** Tjoelker, M.G. (Oak Ridge National Laboratory, TN (USA)); Norby, R.J.; DiCosty, R.J.; Weerasuriya, Y. *Plant Physiology, Supplement (USA)*, 89(4): 15 (Apr 1989).

To assess the ability of foliar nitrate reductase (NR) as a biochemical marker for the impact of nitrogen oxide pollutants on high-elevation forests, we measured needle NR activity in red spruce (Picea rubens Sarg.) saplings at two stands in the Great Smoky Mountains National Park (1,935 m, 1,720 m). Seven times between September 1987 and 1988, branches were cut from selected saplings, and NR activity was assayed on current-year needles, using an in vivo method. NR activity increased to maximum values of 60 nmol g^{-1} h^{-1} in late summer of both years and then declined by 85 percent in October 1987 and 65 percent in

September 1988. Although NR activity was 30 percent great in red spruce at the high site relative to the low site in September and October 1987, NR activity dropped to 10 nmol g^{-1} h^{-1} at both sites in November 1987. No difference between the sites were evident in 1988. The seasonal pattern of needle NR activity at these sites may be due to ontogenetic changes in needle N metabolism and/or extrinsic variation in temperature or nitrogen oxide deposition. Characterization of nitrogen oxide pollutant levels and exposure episodes at high-elevation sites may aid in assessing seasonal and site variation in NR activity and the likelihood of needle NR induction by uptake of nitrogen oxides. These measurements of NR activity indicate that red spruce are capable of reducing nitrate in foliage under field conditions and that the nitrate assimilation capacity varies seasonally.

47730 **Nitrogen metabolism in tabtoxinine-β-lactam-tolerant oats.** Knight, T.J. (Los Alamos National Lab., NM (USA)); Langston-Unkefer, P.J.; Sengupta-Gopalan, C. *Plant Physiology, Supplement (USA)*, 89(4): 17 (Apr 1989).

Infestation of the rhizosphere of oat plants with Pseudomonas syringae pv. tabaci results in rapid death of normal oats. This is a consequence of the action of the bacterially delivered inhibitor of glutamine synthetase, tabtoxinine-β-lactam (TβL). Such infested plants contain no active glutamine synthetase. We have screened for a small population of oats that contain leaf glutamine synthetases that are insensitive to TβL and which have increased leaf GS activity. The root GS is inactive. We have examined these plants' altered nitrogen metabolism and further characterized their novel glutamine synthetase using both biochemical and molecular biological approaches. This investigation has revealed a GS with unusual electrophoretic mobility by native PAGE.

47731 **Inactivation of human and simian rotaviruses by chlorine dioxide.** Chen, Yu-Shiaw (Brookhaven National Lab., Upton, NY (USA)); Vaughn, J.M. *Applied and Environmental Microbiology (USA)*, 56(5): 1363-1366 (May 1990).

The inactivation of single-particle stocks of human (type 2, Wa) and simian (SA-11) rotaviruses by chlorine dioxide was investigated. Experiments were conducted at 4°C in a standard phosphate-carbonate buffer. Both virus types were rapidly inactivated, within 20 s under alkaline conditions, when chlorine dioxide concentrations ranging from 0.05 to 0.2 mg/liter were used. Similar reductions of 10^5-fold in infectivity required additional exposure time of 120 s at 0.2 mg/liter for Wa and at 0.5 mg/liter for SA-11, respectively, at pH 6.0. The inactivation of both virus types was moderate a neutral pH, and the sensitivities to chlorine dioxide were similar. The observed enhancement of virucidal efficiency with increasing pH was contrary to earlier findings with chlorine- and ozone-treated rotavirus particles, where efficiencies decreased with increasing alkalinity. Comparison of 99.9% virus inactivation times revealed ozone to be the most effective virucidal agent among these three disinfectants.

5604 Other Environmental Pollutant Effects

47732 (AD-A-222454/1/XAB) **Mechanisms of microwave-induced damage in biologic materials.** Litovitz, T.A.; Meister, R.; Mohr, R.K.; Montrose, C.J.; Mullins, J.M. Catholic Univ. of America, Washington, DC (USA). Jan 1990. 113p. Contract DAMD17-86-C-6260. Source: NTIS, PC A06/MF A01.

This report is divided into four chapters which correspond to the four main lines of research being carried out under the contract. In brief, these are (1) mathematical modeling studies, (2) experimental spectroscopic studies, (3) engineering design research, and (4) experimental biological studies. The research program is structured to attempt to discover the biological effects at the cell and molecular level that result from exposure to electromagnetic radiation. The main thrust is on the athermal effects of exposure to microwaves. Because recent work has suggested that significant cellular effects occur only when the microwaves are amplitude modulated, either with extremely low frequency (ELF) sinusoids or with pulses, we have hypothesized that the interaction of the microwave fields with cells must involve a demodulation or detection step. As a result, research designed to develop an understanding of the effects of direct ELF exposure becomes not only relevant, but vital.

47733 (PNL-SA-17819) **Interaction of extremely low-frequency electromagnetic fields with humans.** Tenforde, T.S. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-900495-2: Annual meeting of the Division of Physics of Beams of the American Physical Society, Washington, DC (USA), 16-19 Apr 1990). Order Number DE90017190. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Public concern has grown in recent years concerning the possible health effects of extremely low-frequency (ELF) electromagnetic fields to which we are exposed in all aspects of everyday life. By definition ELF refers to the range of electromagnetic field frequencies below 300 Hz, which includes the power transmission and distribution frequencies used throughout the world. In materials with the electrical and magnetic properties of living tissues, these fields have a long wavelength (5000 m) and skin depth (150 m). As a consequence, in their interactions with humans and other living organisms ELF fields behave as though they are composed of independent electric and magnetic fields components. This paper discusses ELF fields and their interactions with humans and other living organisms as well as their biological effects.

47734 (PNL-SA-18314) **ELF [extremely-low-frequency]: Exposure levels, bioeffects and epidemiology.** Anderson, L.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 18p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-900679-7: 1990 Health Physics Society meeting, Anaheim, CA (USA), 24-28 Jun 1990). Order Number DE90016554. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Extremely-low-frequency (ELF) electromagnetic fields arise from a variety of sources including power distribution networks, public transportation systems, electrical appliances and motors, electrically heated beds and blankets, etc. In fact, in an industrialized society, people and animals are bathed in complex milieu of elevated electromagnetic fields. The ways in which exposure to these ELF electric and magnetic fields may affect biological systems are not obvious. Ionizing radiation can interact with neutral molecules to form chemically reactive radical or ionic species; however, ELF radiation transfers energy to tissues at a level lower than is already present in the form of thermal energy. ELF electromagnetic fields, nonetheless, appear to interact with tissue, and in particular with neural tissue in some whole-animal and cellular systems. This paper evaluates possible interactions between the contemporary electromagnetic environment and living organisms, and whether such influences are temporary or long lasting, beneficial or harmful. In studies on electric and magnetic fields, a broad range of exposure levels has been employed from a few volts/meter to more than 100 kV/m, and from 0.01 to 30 millitessla. A equally wide span of biological endpoints have been evaluated for possible response to ELF fields. 26 refs., 1 fig., 1 tab.

47735 (VTT-TUTK-656) **Properties of acoustic energy quantities.** Uosukainen, S. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Turvallisuustekniikan laboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Sep 1989. 233p. Order Number DE90518714. Source: NTIS (US Sales Only), PC A11/MF A01.

The sound power of a source is shown to depend on other sources and environment through the coherent and incoherent interaction and on the mounting conditions of the source. The conditions for a source to be a constant power source (being a rare exception amoung sound sources) are defined. A new quantity semianalytic intensity is defined. By its help the mean value, time-dependent, active and reactive intensity are defined in general time-dependent fields. In time harmonic fields the active part of the mean value intensity is rotational. The rotationality is proportional to the polarization vector of particle velocity, the polarization bein elliptical in general. The changes of sound field are shown to generate rotationality in all intensity components. The negative pI-indicator is shown to be a possible indication of the rotationality of intensity. Fundamental intensity vortices are defined. The size of the lowest order vortices is of the order of 0.5-0.7 λ. A modified J.M.C. method is developed for the basis of the vector and dyadic weighting, the former of which weights the sound pressure and

particle velocity differently, and the latter also changes the polarization (or direction) of the particle velocity. Theoretical possibilities of general field modifications and acoustic sink optimization based on these new field reshapers are presented. A new field indicator for intensity measurements is defined. It can be used as a measure of the diffuseness and reactivity as a function of time and observation direction.

57 HEALTH AND SAFETY

Refer also to citation(s) 46728, 47009

47736 (GEPP-EV–1092) **Safety assessment: Pinellas Plant Child Development Center/Partnership School: Environmental Health and Safety Programs.** General Electric Co., Largo, FL (USA). Neutron Devices Dept. 21 Jun 1990. 186p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00656. Order Number DE90016680. Source: NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This document describes the Child Development Center/ Partnership School and its unique relationship to the Pinellas Plant. The school and its operation are described in detail, along with the administrative and engineering controls in place to ensure the safety of the facility. Special emphasis is placed on the analyses of potential risks to school operations and personnel which may be posed by their close proximity to the plant. A recent Safety Systems Management Assay (SSMA) was used as a guide in describing both routine operations and potential credible accident scenarios at the Pinellas Plant site. The Safety Assessment concluded that, although potential accidents at the Pinellas Plant could result in injury to personnel on the school site, the low probability of these incidents would make operation of the school an acceptable risk. The risks associated with routine operations at the plant are similar to those encountered at a large-scale electronics manufacturing plant. Numerous safeguards are in place to limit the effects of any credible accident on the Pinellas Plant and school site. 32 refs., 18 figs., 33 tabs.

47737 (ORNL/M–1237) **Description of organizational components: Health and Safety Research Division.** Oak Ridge National Lab., TN (USA). Jun 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016498. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Health and Safety Research Division (HASRD) conducts a broad range of basic and applied research in the general area of life sciences at Oak Ridge National Laboratory (ORNL). The specific mission of the Division is to provide a sound scientific basis for the measurement and assessment of human health impacts of energy technologies. Over 200 individuals comprise the regular staff which is augmented by 140 additional subcontractors, guests, postdocs, and students. HASRD maintains national and international leadership in several areas that are important to its mission. This paper contains descriptions of the Division's organizational units provide a brief overview of the current scope of work.

58 GEOSCIENCES

Refer also to citation(s) 46487, 46490, 46491, 46665, 46666, 47285, 47286, 47298, 47491, 47618

47738 (CRIE-U–89040) **Method to evaluate system compliance in dynamic strength tests of gravelly soils.** Tanaka, Y.; Kokusho, T.; Yoshida, Y.; Kudo, K. Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Dec 1989. 39p. (In Japanese). Order Number DE90517064. Source: NTIS (US Sales Only), PC A03/MF A01.

Proposed in this study is the method to simply evaluate the values of C_R and C_{RM} which represent the amplitude of system compliance and membrane compliance respectively. This method is also applicale to undisturbed intact specimens, because the values of C_R and C_{RM} are obtained by the results of non-destructive tests which are made before undrained strength tests. The results of the tests by this method which were applied to indoor reconstituted specimens and undisturbed intact gravelly soil specimens sampled by in-situ freezing sampling, were as follows: The values of C_{RM} of indoor reconstituted specimens were calculated by the proposed method, then they were compared with those of the results obtained by the other methods for the specimens with mean particle size of same grade. As the results, it was found that the both values were nearly equivalent. The difference in the magnitude of the water pressure generated by the distiction with or without the treatment of reducing unevenness on the side surface of undisturbed intact specimens, was able to be explained by the difference in the value of C_R. 18 refs., 20 figs.

47739 (DOE/ER/14058–1) **Cross-hole geotomography in a partially depleted reservoir: Progress report, August 1989–April 1990.** McDonald, J.A.; Gardner, G.H.F.; Leiss, E.L. Houston Univ., TX (USA). Houston Petroleum Research Center. Apr 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-89ER14058. Order Number DE90017329. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The research being carried out is a preliminary examination of the cross-hole technique as a tool for developing tomographs for characterizing reservoirs. The Bureau of Economic Geology (BEG) of the state of Texas has enabled us to gain access to the West 76 Field in Duval County, Texas, which is owned by the state. The hiatus in the field experiments has enabled considerable work to be done on developing software. Personnel in this laboratory have built a physical model that simulates cross-hole experiments. Data generated in this laboratory are being used to check out the cross-hole software so far developed. This paper addresses the problem of making high frequency cross-hole measurements in a partially depleted reservoir, the aim being to improve oil recovery from known reservoirs. 3 refs., 6 figs.

47740 (LBL–27182) **Preliminary prediction of inflow into the D-holes at the Stripa Mine.** Long, J.C.S.; Karasaki, K.; Davey, A.; Peterson, J.; Landsfeld, M.; Kemeny, J.; Martel, S. Lawrence Berkeley Lab., CA (USA). Feb 1990. 100p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90016623. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Lawrence Berkeley Laboratory (LBL) is contracted by the US Department of Energy to provide an auxiliary modeling effort for the Stripa Project. Within this effort, we are making calculations of inflow to the Simulated Drift Experiment (SDE), i.e. inflow to six parallel, closely spaced D-holes, using a preliminary set of data collected in five other holes, the N- and W-holes during Stages 1 and 2 of the Site Characterization and Validation (SCV) project. Our approach has been to focus on the fracture zones rather than the general set of ubiquitous fractures. Approximately 90% of all the water flowing in the rock is flowing in fracture zones which are neither uniformly conductive nor are they infinitely extensive. Our approach has been to adopt the fracture zone locations as they have been identified with geophysics. We use geologic sense and the original geophysical data to add one zone where significant water inflow has been observed that can not be explained with the other geophysical zones. This report covers LBL's preliminary prediction of flow into the D-holes. Care should be taken in interpreting the results given in this report. As explained below, the approach that LBL has designed for developing a fracture hydrology model requires cross-hole hydrologic data. Cross-hole tests are planned for Stage 3 but were unavailable in Stage 1. As such, we have inferred from available data what a cross-hole test might show and used this synthetic data to make a preliminary calculation of the inflow into the D-holes. Then using all the Stage 3 data we will calculate flow into the Validation Drift itself. The report mainly demonstrates the use of our methodology and the simulated results should be considered preliminary.

47741 (LBL–29127) **Further modeling studies of gas movement and moisture migration of Yucca Mountain, Nevada.** Tsang, Y.W.; Pruess, K. Lawrence Berkeley Lab., CA (USA). May 1990. 52p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90016637. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In this report we present modeling studies on moisture redistribution processes that are mediated by gas-phase flow and diffusion. Knowledge of the physical processes and parameter sensitivity studies show that moisture removal from Yucca Mountain arising from a lowered humidity of the soil gas at the land surface is controlled by vapor diffusion. Both the presence of realistic stratigraphy of alternate layers of nonwelded and welded units, and the choice of characteristics curves, have only minor effects on the magnitude of moisture removal, though characteristic curves play a dominant role in defining the equilibrium liquid-saturation profiles of the layered formation. We are therefore able to conclude from our calculations that the rate of moisture removal from vapor transport has an upper limit of about 0.1 mm/yr. Our calculations for stratigraphic columns with alternate layers of nonwelded and welded units show that order-of-magnitude discontinuities in absolute and relative permeabilities at a lithologic contact give rise to artifically large resistance to flow if the usual numerical scheme of harmonic weighting of absolute permeability and upstream weighting of relative permeability is used. We have resolved the numerical difficulty by invoking a physics-based intuitive model of a "fuzzy lithologic contact," and employing a complete 100% upstream weighting of the effective permeability at all interfaces. 33 refs., 22 figs., 2 tabs.

47742 (SKB-TR–89-31) **Interdisciplinary study of postglacial faulting in the Lansjaerv area, Northern Sweden 1986-1988.** Baeckblom, G.; Stanfors, R. (ed.). Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1989. 193p. Order Number DE90639671. Source: NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS.

Post-glacial faults have been recognized in the northern Baltic shield for several decades. It is important to evaluate whether such neotectonic movements can lead to new fracturing or decisively alter the geohydrological or geohydrochemical situation around a final repository for spent nuclear fuel. The post-glacial Lansjaerv fault was chosen for interdisciplinary study because of its relative accessibility. The goals of the study were to assess the mechanisms that caused present day scarps, to clarify the extent of any recent fracturing and to clarify the extent of any ongoing movements. All these objectives were reasonable met through a series of studies. This report describes achievements that have been gained since the study was initiated by SKB 1986. Analysis of geology and geophysics over a 150x200 km region supplemented with seismic networks and field studies at outcrops and trenches set a framework for a cored borehole down to depth of 500 m at the fault. The core has been studied in detail with respect to fracture-infillings in order to analyse mineralogical and geochemical alteration. The borehole has been logged for geophysics, stress, hydraulic conductivity, groundwater pressure and the chemical constituents of the groundwater. Numerical modelling has been undertaken in order to understand the effects of glaciation on the behaviour of a blocky rock mass. Several general conclusions have been made by the interdisciplinary research group. One of the major conclusions is that pre-existing old structures were reactivated by tectonic movements, possibly triggered by deglaciation. In spite of a major earthquake that may have occurred during the deglaciation, and in spite of the anomalous tectonic setting compared to study-sites within SKB:s site investigation programme, the hydraulic conductivity and groundwater chemistry are comparable with results from those sites. (83 figs., 15 tabs., 150 refs.).

47743 (UCID–21406-Rev.1) **MCRT user's guide and documentation: Revision 1.** Jackson, K.J.; Wolery, T.J.; Bourcier, W.L.; Delany, J.M.; Moore, R.M.; Clinnick, M.L.; Lundeen, S.R. Lawrence Livermore National Lab., CA (USA). 15 Nov 1988. 93p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-48. Order Number DE90016652. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

MCRT is a FORTRAN computer program used to generate computer files, containing thermodynamic data for chemical reactions involving solids, gases, and aqueous species. The MCRT code uses basic thermodynamic and reaction stoichiometry information stored in data and input files to produce an output file containing a grid describing the temperature dependence of equilibrium constants of mineral hydrolysis reactions and aqueous dissociation reactions. The reaction properties generated by MCRT comprise a critical portion of the thermodynamic data needed by the geochemical modeling codes in the EQ3/6 software package. The set of files used to store the thermodynamic data for the aqueous, solid, and gaseous species and associated FORTRAN data base manipulation codes are also described in this user's manual. The data base structure and use of the data manipulation programs are described only in sufficient detail to illustrate their relationship to the MCRT code. This user's guide is designed to acquaint a new user with the MCRT program and its associated data files, so as to facilitate the use of the code and its various options. The data base processing programs MDAP and DARP are briefly described, and several sample runs of the programs are included to illustrate the available options. In addition, the structure of the MCRT code, the coding conventions used throughout the EQ3/6 package, and the methods used in MCRT to extrapolate thermodynamic data to elevated temperatures are described. Appendices 1–4 contain descriptions of the important variables defined in MCRT and a glossary of subroutines called by MCRT. 21 refs.

47744 (UCRL–52000-90-5/6) **Energy and technology review, May–June 1990.** Burnham, A.K.; MacCracken, M.; Crawford, R.; de Vore, L.; Gardner, D.R.; Gleason, K.; Kirvel, R.D.; Sanford, N.M.; Taft, S.O. (eds.). Lawrence Livermore National Lab., CA (USA). May 1990. 70p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90014837. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document is published monthly by Lawrence Livermore National Laboratories (LLNL) to report on progress for the several programs currently being conducted. Specific articles are: atmospheric and geophysical sciences at LLNL; growth of ARAC to meet demand; Mesoscale monitoring, determining the effects of topography on atmospheric flaws; modeling radionuclide dispersion in the atmosphere; releases of heavier-than-air and toxic gases; cloud dynamics and microphysics; tropospheric chemistry, microphysics, and climate change; protecting the ozone layer; and systematic comparison of global climate models. 28 refs., 35 figs., 3 tabs. (FI)

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47745 (INIS-mf–12695) **PSI nuclear and particle physics newsletter 1988: PSI annual report 1988 annex I.** Frosch, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Furrer, F. (eds.). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1989. 79p. Order Number DE90638737. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The present Newsletter contains reports on nuclear and particle physics supported by the F1 division of PSI. Groups were invited to present new preliminary or final results obtained in 1989. As usual there has been no refereeing. The contributions must not be quoted without previous consultation with the authors. Spokespersons are indicated by superscripts 'S' following their names in the headings of the contributions. (author) 65 figs., 9 tabs., 189 refs.

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Refer also to citation(s) 47242, 47824, 47854

47746 (AD-A–221975/6/XAB) **Application of solar seismology to study of the convection zone. Final report, 1 January 1987-31 December 1989.** Hill, H.A. Arizona Univ., Tucson, AZ (USA). Dept. of Physics. 9 May 1990. 14p. Grant AFOSR-87-0105. Source: NTIS, PC A03/MF A01.

Progress has been made in the program to use solar seismology as a tool for the understanding and potentially the forecasting of solar variability. Changes in the velocity of sound profile and nonadiabatic effects in the internal equilibrium condition of the convection zone over a six year period have been inferred from observed changes in the frequencies of low-order acoustic moses and intermediate degree f-modes. These changes may be associated with the eleven year solar cycle. The observed spectrum of gravity-modes has been used to infer a discontinuity in the mean molecular weight in the Sun's core and to place an upper limit on the density of WIMPS (Weakly Interacting Massive Particles) proposed to

explain the solar neutrino paradox. The interred upper limit, if confirmed in future work removes the WIMPS proposal as a viable option. Evidence for gravity-mode coupling has been extended from 4 multiplets to 20. This evidence for mode coupling leads to interesting predictions concerning the solar neutrino flux. New differential radius observations were obtained in 1988 and 1989.

47747 (AD-A–222222/2/XAB) **Infrared observations of the solar system in support of Large-Aperture Infrared Telescope (LARITS): Calibration. Final technical report, 1 July 1985-28 February 1989.** Shorthill, R.W. Utah Univ., Salt Lake City, UT (USA). Dept. of Mechanical Engineering. 2 May 1990. 22p. Grant AFOSR-85-0181. Source: NTIS, PC A03/MF A01.

The Purpose of this project was to improve the infrared calibration base for infrared detectors. Groundbased infrared measurements of solid-surfaced planetary bodies, such as asteroids, are being used for the calibration of spacecraft detectors. A limitation has been the relatively poor theoretical understanding of thermal emission from these objects. The goal was to: (1) develop a database of sources and, (2) improve or modify the thermal models for these sources to provide a calibration data base for spacecraft infrared detector systems. The technique consisted of five phases: (1) design and construct infrared detector system to be used with and without collecting optics, (2) acquire whole-disk infrared lunar data relative to a laboratory blackbody and tie them to Mars (Venus or Mercury) and Vega, (3) compare with thermophysical model of the mood and modify, (4) acquire infrared asteroid photometry, (5) compare the lunar disk photometry the asteroid calibrators using photometry and thermophysical models. The Si bolometer is calibrated without optics, attached to the portable telescope drive and Lunar disk measurement made. Next the bolometer is attached to the 90 inch telescope, Lunar scans are made and the remaining objects (planets, stars, asteroids) are measured.

47748 (AD-A–222245/3/XAB) **Infrared observations of the solar system in support of Large-Aperture Infrared Telescope (LARITS): Calibration. Appendices. Final technical report, 1 July 1985-28 February 1989.** Shorthill, R.W. Utah Univ., Salt Lake City, UT (USA). Dept. of Mechanical Engineering. 1 Apr 1990. 165p. Grant AFOSR-85-0181. Source: NTIS, PC A08/MF A01.

Appendix to AD-A222 222.

An infrared (I.R.) optics package designed for a I.R. detector calibration survey will be used in conjunction with the 90 inch telescope at the University of Wyoming, or as a portable, stand along unit. An important part of this instrument package is a mechanical light beam chopper which rotates with a fixed phase relation with respect to a wobbling secondary mirror in the telescope. A control circuit synchronizes the chopper to an external signal when used at the Wyoming site, or generates an internal reference frequency when used as a portable system. The portable system consists of a small equatorial telescope mount to support the same I.R. instrumentation package, which is used without additional optics. An automated positioning and tracking system encorporates a personal computer to control the environment of the telescope mount via stepper motors attached to the drive axis. The computer is also used to record all data on floppy disc for both fixed and portable systems.

47749 (DOE/ET/53088–446) **Propagation of magnetoacoustic waves in the solar atmosphere with random inhomogeneities of density and magnetic fields.** Ryutova, M. (AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki); Kaisig, M.; Tajima, T. Texas Univ., Austin, TX (USA). Aug 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–446). Order Number DE90017616. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Effects of strong and random inhomogeneities of the magnetic fields, plasma density, and temperature in the solar atmosphere on the properties of magnetoacoustic waves of arbitrary amplitudes are studied. The procedure which allows one to obtain the averaged equation containing the nonlinearity of a wave, dispersion properties of a system, and dissipative effects is described. It is shown that depending on the statistical properties of the medium, different scenarios of wave propagation arise: in the predominance of dissipative effects the primary wave is damped away in the linear stage and the efficiency of heating due to inhomogeneities is much greater than that in homogeneous medium. Depending on the interplay of nonlinear and dispersion effects, the process of heating can be afforded through the formation of shocks or through the storing of energy in a system of solitons which are later damped away. Our computer simulation supports and extends the above theoretical investigations. In particular the enhanced dissipation of waves due to the strong and random inhomogeneities is observed and this is more pronounced for shorter waves.

47750 (KU-HCOE-FL2-R–90-6) **Moessbauer spectroscopy of ^{57}Fe and the evolution of the solar system.** Knudsen, J.M. (Copenhagen Univ. (Denmark). Fysisk Lab.). Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1990. 31p. Order Number DE90639030. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The article starts with a brief review of ideas on the origin of the solar system, with emphasis on the cosmic history of the element iron. Some examples of the application of Moessbauer spectroscopy to the study of iron compounds from various types of meteorites, which represent different stages of the evolution of the planetary system, then follow. (orig.).

47751 (LA-UR–90-2389) **Late stages in the evolution of classical novae.** Starrfield, S. (Arizona State Univ., Tempe, AZ (USA). Dept. of Physics); Krautter, J.; Sonneborn, G. Los Alamos National Lab., NM (USA). [1990]. 26p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9005248–2: Evolution in astrophysics: IUE astronomy in the era of new space missions, Toulouse (France), 29 May - 1 jun 1990). Order Number DE90014911. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have begun a study of the long term evolution of novae in outburst in order to determine the means by which they return in quiescence when nuclear burning has ended. This project involves both IUE and optical observations and theoretical predictions. Recently, in the initial observational part of this project, we have obtained IUE SWP spectra of GQ Mus 1983 and QU Vul 1984. Each spectrum was a 16 hour exposure using a combined US1 plus Vilspa shift. No novae have been studied in the UV for as long as QU Vul and GQ Mus and observations of their spectral evolution are providing unique data on the turn-off time scale. We have also obtained the spectra of old novae from the IUE archives in order to compare and contrast the existing spectra with those of GQ Mus and Qu Vul. The theoretical prediction is that a nova should be very hot just before turnoff but x-ray observations from EXOSAT do not confirm this prediction. 18 refs., 12 figs., 1 tab.

47752 (LA-UR–90-2764) **Coronal heating by nanoflares: Plasma dynamics of elementary events.** Kopp, R.A. (Los Alamos National Lab., NM (USA)); Poletto, G. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by Consiglio Nazionale delle Ricerche, Gruppo Nazionale di Astronomia; U.S. DOE Defense Programs; Italian Space Agency; Universita di Firenze. DOE Contract W-7405-ENG-36. (CONF-9006261–1: Mechanisms of chromospheric and coronal heating, Heidelberg (Germany, F.R.), 5-8 Jun 1990). Order Number DE90016495. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It has been suggested by Parker Sturrock et al., and others that the corona may be stochastically heated, on spatial scales at or below current instrumental resolution limits, by a continuous succession of many small flarelike events commonly referred to as nanoflares. In this paper we extend a semi-analytical "point" model developed previously for solar compact flares, to include gravitational plasma downfall during the late decay phase. Applying the model to conditions representative of nanoflares allows us to predict the temporal variation of average plasma properties in such events and should ultimately facilitate a calculation of the spectral characteristics of a nanoflare-heated corona. 7 refs., 2 figs.

47753 (LA-UR–90-2851) **Design, performance, and calibration of the ALEXIS ultrasoft x-ray telescopes.** Bloch, J.J. (Los Alamos National Lab., NM (USA)); Ameduri, F.; Priedhorsky, W.C.; Roussel-Dupre, D.; Smith, B.W.; Siegmund, O.H.W.; Cully, S.; Warren, J.; Gaines, G.A. Los Alamos National Lab., NM (USA).

[1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9007157–1: SPIE conference on EUV x-ray and gamma-ray instrumentation for astronomy, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90016483. Source: NTIS, PC A03/MF A01 - OSTI.

The Array of Low Energy X-ray Imaging Sensors (ALEXIS) experiment consists of six wide angle EUV/ultrasoft x-ray telescopes utilizing normal incidence multilayer mirrors, flown a miniature satellite to map out the sky in three narrow bandpasses around 66, 71, and 95 eV. The 66 and 71 eV bandpasses are centered on intense Fe emission lines which are characteristic of million degree plasmas such as the one thought to produce the soft x-ray background. The 95 eV bandpass has a higher throughput and is more sensitive to continuum sources. The mission will be launched into orbit on the Pegasus Air Launched Vehicle in mid-1991. We will present the details of the ALEXIS telescope optical design, initial characterizations of the first flight mirrors and detectors, and the current schemes for characterizing and calibrating the completed telescope assemblies. We will also discuss the details of a novel "wavetrap" feature incorporated into the multilayer mirror structure to greatly reduce the mirror's reflectivity at 304 Å, a major background contamination flux of He II emission from the geocorona. 2 refs., 13 figs.

47754 (LA-UR–90-2903) **A semi-analytical model of stellar flares.** Kopp, R.A. (Los Alamos National Lab., NM (USA)); Poletto, G. Los Alamos National Lab., NM (USA). [1990]. 4p. Sponsored by Consiglio Nazionale delle Ricerche, Gruppo Nazionale di Astronomia; U.S. DOE Office of Administration and Human Resource Management; Italian Space Agency; Universita di Firenze. DOE Contract W-7405-ENG-36. (CONF-9007158–1: Armagh international colloquium: surface inhomogenities, Armagh (Ireland), 24-27 Jul 1990). Order Number DE90016434. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present a simplified "point" model to describe the hydrodynamic response of coronal loop plasma to the sudden release of energy which occurs at the time of a flare. Our simplification allows the full set of partial differential equations for energy, momentum, and mass conservation to be replaced by a corresponding set of ordinary differential equations for the plasma properties averaged over the loop volume. The temporal profiles of plasma temperature, density, and velocity are calculated over a time interval long enough to ensure that pre-flare conditions are re-established. The model is used for the interpretation of stellar flare data. In particular, we derive a set of representative loop geometries and flare energy inputs which allows us to reproduce the high emission measures typically inferred from observations of stellar flares. 4 refs., 1 fig.

47755 (LA-UR–90-2909) **Nuclear structure calculations for astrophysical applications.** Moeller, P. (Lund Univ. (Sweden). Dept. of Mathematical Physics); Nix, J.R.; Kratz, K.L.; Howard, W.M. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9006212–2: International symposium on nuclear astrophysics: nuclei in the cosmos, Vienna (Austria), 18-22 Jun 1990). Order Number DE90016433. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Relative to other fields of physics, astrophysics is probably unique in its requirement that a very large number of physical environments be modeled to achieve a satisfactory description of the phenomena under study. The dynamics of the cosmos is governed by interactions that span a vast range, from subnucleon, nucleon and nuclear distances to distances affected by the gravitational interactions, which extends over the width of a galaxy and beyond, to the edge of the universe. It is the nuclear processes that provide much of the energy that drives the macroscopic behavior of the cosmos. Through this energy release the behavior on the very small scale is coupled to the very large-scale behavior. On the nuclear level, cross sections, nuclear decay energies and nuclear decay paths are but a few examples of quantities that are of paramount importance in astrophysical models. Because nuclei of extreme composition, quite different from what can be studied on earth, exist in stellar environments, an understanding of the nuclear structure properties of these nuclei can only be obtained through theoretical means. This presents a continuing, stimulating challenge to the nuclear-physics community. Here we present calculated results on such diverse properties as nuclear energy levels, ground-state masses and shapes, β-decay properties and fission-barrier heights. Our approach to these calculations is to use a unified theoretical framework within which the above properties can all be studied. The results are obtained in the macroscopic-microscopic approach in which a microscopic nuclear-structure single-particle model with extensions is combined with a macroscopic model, such as the liquid-drop model.

47756 (NORDITA–90/12-A(prepr.)) **Stability properties of an isothermal accretion disk.** Wallinder, F.H. (International School for Advanced Studies, Trieste (Italy)). Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark). 1990. 5p. Order Number DE90639034. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A local stability analysis of an isothermal, transonic accretion disk around a non-rotating black hole is used to infer the time-dependent behaviour of linear perturbations. The three modes in the problem are one viscous Lightman-Eardley mode, which is always stable, and two acoustic modes, which are always overstable. If the growth rate is required to be greater than the escape rate, then the acoustic modes become stable in the outer region, and unstable in the innermost region, if the viscosity parameter α is greater than 0.5. (orig.).

47757 (NORDITA–90/14-A(prepr.)) **A spin-down mechanism for accreting neutron stars.** Illarionov, A.F. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)); Kompaneets, D.A. Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark). 1990. 19p. Order Number DE90639035. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We propose a new spin-down mechanism for accreting neutron stars that explains the existence of a number of long-period ($p \simeq 100$-1000 s) X-ray pulsars in wide binaries with OB-stars. The spin-down is a result of efficient angular momentum transfer from the rotating magnetosphere of the accreting star to an outflowing stream of magnetized matter. The outflow is formed within a limited solid angle, and the outflow rate is less than the accretion rate. The outflow formation is connected with the anisotropy and intensity of the hard X-ray emission of the neutron star. X-rays from the pulsar heat through Compton scattering the accreting matter anisotropically. The heated matter has a lower density than the surrounding accreting matter and flows up by the action of the buoyancy force. We find the criterion for the outflow to form deep in the accretion flow (i.e., close to the neutron star magnetosphere). The neutron star loses angular momentum when the outflow forms so deep as to capture the magnetic field lines from the rotating magnetosphere. The balance between angular momentum gain by accreting gas and loss by outflowing matter takes place at a particular value of the period of the spinning neutron star. (orig.).

47758 Searching for halo dark matter through γ ray lines. Salati, P. (LAPP, BP110, 74941 Annecy-le-Vieux Cedex (FR)); Bouquet, A.; Silk, J. pp. 369-377 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper studies the possibility of detecting halo cold dark matte through the annihilation process $X\bar{X} \rightarrow \gamma$. While such a process produces monoenergetic γ rays, and would be a clear signature of particle dark matter, the authors show that it will be very difficult to observe if there is a closure density of dark matter.

47759 Very high energy gamma-ray astronomy: On the threshold. Weekes, T.C. (Whipple Observatory, Harvard-Smithsonian Center for Astrophysics, Amado, AZ (US)). pp. 372-386 of Proceedings of the fourteenth Texas symposium on relativistic astrophysics: Volume 571. Fenyves, E.J. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-881268–: 14. Texas symposium on relativistic astrophysics, Dallas, TX (USA), 11-16 Dec 1988).

It is apparent that very high gamma-ray astronomy, at the very end of the electromagnetic spectrum, is just at the threshold of becoming an important channel of astronomical information. The author discusses how, to fully develop, it requires telescopes with improved minimum flux sensitivity; development of techniques that characterize the nature of the primary; more overlapping observations to remove any question of the reality of the detected phenomenon; more consistency in the application of statistics among experimenters and more openness about methods used; development of models that will predict the phenomenon to be expected rather than explain what has been observed; and more accurate calibrations to determine absolute fluxes and energies.

47760 **Dark matter and the solar neutrino problem: Can particle physics provide a single solution.** West, G.B. (Los Alamos National Lab., NM (USA). Theoretical Div.). pp. 469-478 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper shows how a relatively simple extension of the standard model can give a natural explanation for both the solar neutrino and dark matter problems. What is required is a new stable neutral lepton with a mass in the 4 to 8 GeV range. According to this analysis, this model has led to many eminently testable predictions. The particles talked about all have masses in a range easily accessible to present-day facilities.

47761 **Neutrino-electron scattering and the choice between different MSW solutions of the solar neutrino problem.** Rosen, S.P. (Los Alamos National Lab., NM (USA). Theoretical Div.); Gelb, J.M. pp. 468 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper considers the scattering of solar neutrinos by electrons as a means for distinguishing between different MSW solutions of the solar neutrino problem. In terms of the ratio R between the observed cross-section and that for pure electron-type neutrinos, some correlation between the value of R and each solution is found. A value of $R \leq 1/3$ implies that the adiabatic solution is correct, while values between 1/3 and 3/5 are consistent with the large angle solution. A value close to 1/2 is also consistent with the non-adiabatic solution, and a value less than (1/6 - 1/7) implies oscillations into sterile neutrinos.

47762 **Neutrino counting with the SLD at the Stanford Linear Collider.** Band, H. (Wisconsin Univ., Madison, WI (USA). Dept. of Physics); Bugg, W.; Chadwick, G.; Messner, R.; Reutens, P.; Young, C.; Coyne, D.; Gyure, M.; Nauenberg, U.; Hertzbach, S. pp. 445-459 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). Grant SLAC-PUB-4990. (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper examines the relative merits of several methods for determining the number of neutrino generations with the SLD at the Stanford Linear Collider. The authors conclude that in the limit of large statistics, the most precise technique is a measurement taken at a collision energy of 96 GeV of the ratio of the cross sections for the processes $e^+e- \rightarrow \gamma$ to $e^+e- \rightarrow - \nu\gamma$, for which errors smaller than 0.10 N_ν should be achievable. Alternatively, if 10^6 Z^0 events are collected at the Z^0 resonance peak, this measurement will provide a precision of about 0.15 N_ν. The authors give a summary of the relative performance of the experimental methods examined in this paper as a function of the size of the available data sample.

47763 **Cosmic gamma-ray bursts: An overview of recent results.** Hurley, K. (California Univ., Berkeley, CA (USA). Space Sciences Lab.). pp. 442-459 of Proceedings of the fourteenth Texas symposium on relativistic astrophysics: Volume 571. Fenyves, E.J. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-881268–: 14. Texas symposium on relativistic astrophysics, Dallas, TX (USA), 11-16 Dec 1988).

This paper reviews the essential aspects of the gamma-ray burst (GRB) phenomenon, with emphasis on the more recent results. GRBs are introduced by their time histories, which provide some evidence for a compact object origin. The energy spectra of bursts are presented and they are seen to demonstrate practically unambiguously that the origin of some GRBs involves neutron stars. Counterpart searches are reviewed briefly and the statistical properties of bursters treated. This paper presents a review of the three known repeating bursters (the Soft Gamma Repeaters). Extragalactic and galactic models are discussed and future prospects are assessed.

47764 **Cyclotron resonant scattering in the spectra of gamma-ray bursts.** Lamb, D.Q. (Chicago Univ., IL (USA). Dept. of Astronomy and Astrophysics); Wang, J.C.L.; Loredo, T.J.; Wasserman, I.; Fenimore, E.E. pp. 460-481 of Proceedings of the fourteenth Texas symposium on relativistic astrophysics: Volume 571. Fenyves, E.J. The New York Academy of Sciences, New York, NY (USA) (1989). Grant NAGW-666. (CONF-881268–: 14. Texas symposium on relativistic astrophysics, Dallas, TX (USA), 11-16 Dec 1988).

Gamma-ray bursts were discovered over twenty years ago, yet their nature and origin have remained a profound mystery. Previous research reported single low- energy ($E \approx 50$ keV) dips in the spectra of more than 20% of the bursts observed with the Konus experiment on Venera 11-14. This paper shows the spectra of two such bursts, GB790412 and GB790612. Previous research reported single low-energy dips in several bursts observed with HEAO-1 A4. This paper shows the spectrum for the strongest of these bursts, GB780325. These features have been interpreted as due to absorption at the cyclotron first harmonic (fundamental), $E_B \approx 11.6\ B_{12}$ keV, where B_{12} is the magnetic field strength in units of 10^{12}G.[5-8] They constitute the strongest evidence in favor of a magnetic neutron star origin for γ-ray bursts.

47765 **Particle physics uses of x-ray binaries.** Domokos, G. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics and Astronomy); Elliot, B.; Kovesi-Domokos, S.; Mrenna, S. pp. 663-671 of Proceedings of the fourteenth Texas symposium on relativistic astrophysics: Volume 571. Fenyves, E.J. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-881268–: 14. Texas symposium on relativistic astrophysics, Dallas, TX (USA), 11-16 Dec 1988).

The principal aim of this report is to discuss the search for a substructure going beyond quarks and leptons as elementary constituents of matter. A previous study argued for the existence of some new physics going beyond the current Standard Model. Composite models of quarks and leptons have a chance of making the next step necessary towards a better understanding of the fundamental processes. It is argued that the onset of the new physics should be observable at energies that correspond to only a few TeV in the CMS in a lepton-lepton or lepton-nucleon collision: such energies are available in the radiation emitted by sources like CYG X3, HER X1, etc. After this, the authors discuss some of the expected signatures of the new physics; these are confronted with some of the observational puzzles and the authors argue that, at least qualitatively, most of the puzzles find a natural explanation in terms of the proposed new physics. The reasoning is then illustrated on the analysis of data on CYG X3. Throughout this discussion, the natural system of units is used.

47766 **Near zero: Toward a quantum-limited resonant-mass gravitational radiation detector.** Michelson, P.R. (Stanford Univ., CA (USA). Dept. of Physics); Bassan, M.; Boughn, S.; Giffard, R.P.; Hollenhorst, J.N.; Mapoles, E.R.; McAshan, M.S. pp. 713-730 of Near zero: New frontiers of physics. Fairbank, J.D.; Deaver, B.S. Jr.; Everitt, C.W.F.; Michelson, P.F. W. H. Freeman and Company, New York, NY (USA) (1988).

This paper reports on projects having to directly establish the existence of gravitational radiation and to use gravitational radiation as a tool for astronomical observation.

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Refer also to citation(s) 46477

47767 (AD-A-222239/6/XAB) **Atomic and molecular collision aspects of thermospheric uranium-vapor releases. Technical report, 15 February 1980-31 December 1985.** Hamlin, D.A. Science Applications International Corp., San Diego, CA (USA). 1 May 1990. 137p. Contracts DNA001-83-C-0055, DNA001-80-C-0137. (SAIC--89/1483). Source: NTIS, PC A07/MF A01.

The DNA Uranium (Oxides) LWIR Review Committee considered the effectiveness of field measurements of the LWIR from uranium oxides produced by (hypothetical) controlled releases of uranium vapor from rockets in the thermosphere. Collated here is the writer's work supporting the committee on atomic and molecular collision aspects of such releases. Included is an essential auxiliary study to (a) understand, in terms of atomic and molecular parameters, coefficients for Ba+ diffusion along the magnetic field as measured and predicted for Ba-release events and (b) apply that (limited) understanding to U-release studies. For particles colliding with neutral atmospheric species, several interaction potentials are used to compute velocity-dependent momentum-transfer cross sections, stopping power and range versus energy, and diffusion coefficients. The momentum-transfer cross sections are also compared with cross sections for certain uranium oxide reactions specially atom-transfer reactions.

47768 (AD-A-222260/2/XAB) **Control of auroral-zone dynamics and thermodynamics by the interplanetary magnetic field dawn-dusk (Y) component.** Sica, R.J.; Hernandez, G.; Emery, B.A.; Roble, R.G.; Smith, R.W. Washington Univ., Seattle, WA (USA). 1 Sep 1989. 13p. Grant AFOSR-89-0316. Source: NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 94, No. A9, 11921-11932(1 Sep 1989).

It is well known that ion drag momentum forcing is one of the primary drivers of the thermospheric wind at high latitudes. Previous theoretical and experimental studies have shown that the dawn-dusk component of the interplanetary magnetic field (IMF By) expands the classical symmetric two-cell convection pattern toward dusk (By negative) or toward dawn (By positive) in the northern hemisphere, altering the ion drag forcing on the neutral atmosphere. Measurements of the neutral dynamics associated with these convection patterns have been presented primarily at magnetic latitudes greater than 70 deg. in the polar cap.

47769 (AD-A-222275/0/XAB) **Analytical studies of magnetospheric pulsations. Final report, 1 July 1986-31 December 1989.** Hameiri, E. New York Univ., NY (USA). Courant Inst. of Mathematical Sciences. Feb 1990. 9p. Grant AFOSR-86-0167. Source: NTIS, PC A02/MF A01.

The research carried out may be divided into four main areas, each involving a number of sub-projects. The main areas are: (1) MHD theory of magnetospheric micropulsations, (2) Kinetic magnetospheric waves, (3) Ballooning modes in the geo-magnetospheric; and (4) Development of a general theory of ballooning modes. The work has resulted in 10 articles listed at the end of the report.

47770 (AD-A-222435/0/XAB) **Near-earth orbital environment coupling to its energy sources. Final report, 1 March 1987-28 February 1990.** Olsen, W. McDonnell Douglas Space Systems Co., Huntington Beach, CA (USA). 21 May 1990. 79p. Contract F49620-87-C-0039. Source: NTIS, PC A05/MF A01.

Under the present study the qualitative work performed earlier has been extended to perform quantitative calculations of the entry of plasma into the magnetosphere. These calculations include the structure of the low-latitude boundary layer and the energy spectrum of the particles within the plasma sheet. These calculations were performed using actual satellite data and virtually no assumed parameters. The success of these calculations provides impressive evidence for the validity of the Gradient Drift Entry theory. It also proves that the widely held notion that the magnetosheath cannot be the source of plasma sheet particles is in error. The success of this study permits the development of quantitative models of the magnetosphere required for the prediction of magnetospheric and upper atmospheric and ionospheric effects on those hardware systems which must operate in Earth orbital space.

47771 (AD-A-222529/0/XAB) **Observations of plasma structure freezing scale at equatorial latitudes. Technical report.** Livingston, R.C.; Vickrey, J.F. SRI International, Menlo Park, CA (USA). May 1990. 52p. Contract DNA001-86-C-0002. Source: NTIS, PC A04/MF A01.

This report made the most comprehensive experimental study of the spectral characteristics of equatorial ionospheric F region structure carried out to date. This investigation has included rf propagation measurements as well as in-situ satellite and rocket observations scanning both vertically and horizontally across the magnetic field. Provided that care is taken to avoid strong scatter effects in the propagation data, all of the techniques provide a similar characterization of the plasma concentration fluctuation spectrum-a two-component power law form. The agreement between the horizontal and vertical scans indicates isotropy of the plasma irregularities in the plane perpendicular to the magnetic field. The freezing scale, which we have identified with the break or change of slope of the power spectrum, moves to larger scale sizes with increasing altitude. The dependence of this behavior is well matched by the inverse of the ion-neutral collision frequency.

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Refer also to citation(s) 47148, 47162, 47224, 47429, 47761, 47828, 47865, 47908, 47975, 47986, 47990, 48067

47772 (AD-A-221973/1/XAB) **Structure and dynamics of excited atoms. Final report, 1 November 1986-31 October 1989.** Gallagher, T.F. Virginia Univ., Charlottesville, VA (USA). Mar 1990. 20p. Grant AFOSR-87-0007. Source: NTIS, PC A03/MF A01.

We have studied processes in excited atoms driven by strong microwave radiation fields to gain a quantitative understanding of what are usually thought of as highly nonlinear processes. We have discovered that circularly polarized microwave fields produce ionization only at fields above 1/16n4, the much higher field required for static field ionization. We have also observed above threshold ionization at microwave frequencies and shown that in the microwave regime it is easily described by a classical theory, which ties together above threshold ionization at microwave frequencies and shown that in the microwave regime it is easily described by a classical theory, which ties together above threshold ionization and ponderomotive energy shifts. Finally, we have made significant progress toward observing collisions which begin and end under control.

47773 (AD-A-222117/4/XAB) **Laboratory study of ion-neutral collisions at suprathermal energies. Interim report, January 1988-December 1989.** Gardner, J.A.; Dressler, R.A.; Salter, R.H.; Murad, E. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 28 Dec 1989. 49p. Source: NTIS, PC A03/MF A01.

A double mass-spectrometer system for the study of the dynamics of ion-neutral collisions at suprathermal energies is described in detail. The system consists of a Wien Filter, which acts as a source of mass-selected and velocity analyzed ions, coupled to a static-pressure collision chamber followed by a quadrupole mass filter, which acts as a mass analyzer for the products and the projectile ions. This apparatus has been used to measure ion-neutral collision cross sections and ion product times-of-flight. The methods utilized in the processing of raw experimental data are also described. The raw cross section data is corrected with respect to the collection efficiency, yielding integral cross sections which can be used in codes designed to predict the environment of spacecraft in low earth orbit. The performance of the experiment is demonstrated by measuring the known ion-neutral collision systems: N2(+) + Ar, N2(+) + D2, and O+ + H2O.

47774 (AD-A-222560/5/XAB) **Detection of vibrationally excited H_2 (v) for H^- production. Final report, 1 September 1986-31 August 1989.** Bischel, W.K.; Robie, D.C.; Peterson, J.R. SRI International, Menlo Park, CA (USA). 15 Sep 1989. 68p. Contract F49620-86-C-0112. (SRI-MP--89-183). Source: NTIS, PC A04/MF A01.

Research was performed to develop laser-based detection of high-lying vibrational levels of Hydrogen to aid the development of high intensity H^- ion production from H_2 plasmas. A new type source of vibrationally excited H2 was developed, and a 2-photon resonantly enhanced multiphoton ionization (REMPI) was developed and was successful in detecting H2(v) in levels up to v = 11. A technique was developed for measuring the tuning range and bandwidth of a tunable ArF laser used to generate vacuum-ultraviolet photons. Two-photon absorption cross sections for X yields EF excitation in H2 were calculated for a wide range of X and EF vibrational levels. Attempts to use both one- and two-photon laser-induced fluorescence to detect excited levels were unsuccessful.

47775 (BONN-AM-89-05) **A functional representation of correlations in inhomogeneous many-electron systems.** Dietz, K. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.); Hess, B.A. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Jul 1989. 22p. Source: Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

We discuss the Legendre conjugate of the Hohenberg-Kohn energy-density functional, i.e. the total energy of an inhomogeneous many-electron system considered as a functional of the external Coulomb potential (the nuclear Coulomb skeleton of a molecule, for instance) as the starting point of an alternative formulation of a theory of electronic correlations. We then relate this functional to the non-relativistic or relativistic microscopic many-body theory. The essential bridge between the two theories is many-body perturbation theory perturbing around a mean-field. We then point out that a particular choice for the latter, the g-Hartree mean-field, leads to a transparent physical picture: the relevant functional of the external field, g_0-1, representing electronic correlations is interpreted as a polarisation charge density induced by the latter. This picture, in turn, leads to a Clausius-Mosotti type of equation for this correlation functional. Applications to atomic and molecular structure calculations are discussed. (orig.).

47776 (BONN-IR-90-04) **The electron-hydrogen problem in hyperspherical coordinates.** Hergarten, S. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Jan 1990. 124p. (In German). Source: Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

The hyperspherical coordinate formalism is applied to the electron hydrogen problem. Using surface functions the three body binding energy is calculated as well as elastic and inelastic scattering parameters. (orig.).

47777 **Atomic processes in plasmas.** AIP Conference Proceedings 206. Kim, Yong-Ki (National Inst. of Standards and Technology, Gaithersburg, MD (USA)); Elton, R.C. 290p. American Institute of Physics, New York, NY (USA) (1990). Sponsored by U.S. DOE Energy Research; Lawrence Livermore National Laboratory. DOE Contract W-7405-ENG-48. From 7. American Physical Society topical conference on atomic processes in plasmas; Gaithersburg, MD (USA); 2-5 Oct 1989.

This report contains 22 papers on the following topics: atomic processes; databases on atomic processes; low-density plasmas; dense plasmas; and XUV lasers. (LSP)

47778 (CONF-9009221-3) **A technique for the measurement of electron attachment to short-lived excited species.** Christophorou, L.G. (Oak Ridge National Lab., TN (USA)); Pinnaduwage, L.A.; Bitouni, A.P. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC05-84OR21400. CHE-8813466. From 6. international symposium on gaseous dielectrics; Knoxville, TN (USA); 23-27 Sep 1990. Order Number DE90016873. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A technique is described for the measurement of electron attachment to short-lived ($\lesssim 10^{-9}$ s) excited species. Preliminary results are presented for photoenhanced electron attachment to short-lived electronically-excited states of triethylamine molecules produced by laser two-photon excitation. The attachment cross sections for these excited states are estimated to be $>10^{-11}$ cm^2 and are $\sim 10^7$ larger compared to those for the unexcited (ground-state) molecules. 8 refs., 4 figs.

47779 (DOE/ER/53217-4) **Theoretical atomic physics for fusion: 1990 Annual report.** Pindzola, M.S.; Legg, J.I.; Perez, J.D.; Parks, P. Auburn Univ., AL (USA). Dept. of Physics. Aug 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER53217. Order Number DE90017280. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The understanding of electron-ion collision processes in high temperature plasmas remains a key factor in the ultimate development of nuclear fusion as a viable energy source for the nation. Our 1990–1992 research proposal delineated. Excitation, ionization and dielectronic recombination as the main areas of research in electron-ion scattering theory. In this paper we summarize our 1990 efforts in each of these research areas.

47780 (FRCEA-TH-282) **Collective flow studies in central collisions between nuclei at several hundreds of MeV per nucleon.** Demoulins, M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie; Paris-11 Univ., 91 - Orsay (France). 1989. 211p. (In French). Order Number DE90514687. Source: NTIS (US Sales Only), PC A10/MF A01.

The main purpose for studying collisions between heavy nuclei in the 200-2000 MeV per nucleon energy range is to determine the equation of state and the properties of dense and hot nuclear matter. The insensitivity of the inclusive data to the equation of state has led experimental physicists to build large solid angle detectors capable of detecting simultaneously the tens of particles emitted in each event. Such measurements allow to estimate the impact parameter, the reaction plane on an event-by-event basis, and to calculate various global variables involving all particles emitted in each event. In this thesis we study global variables which characterize the nuclear matter collective flow in a direction which is different from the direction of incident motion, for argon-nucleus collisions at 400 and 600 MeV by nucleon and for neon-nucleus collisions at 400 and 800 MeV by nucleon. The measurements have been performed with the DIOGENE detector at SATURNE. For the argon-beam experiments, two parallel plate avalanche counters have been used to locate the interaction point of each incoming ion with the target, which improves the reconstruction of the particle tracks in the DIOGENE central chamber. Double differential cross sections in the reaction plane and in the plane orthogonal to the reaction plane are fitted with two-dimensional Gaussian distributions, getting rid of geometrical acceptance effects. Several quantities related to the collective flow (flow angle, aspect ratios, flow parameter) are thus extracted and corrected for the fluctuations of the estimated reaction plane. For the argon-nucleus collisions at 400 MeV by nucleon our results are in agreement with results obtained by other groups with different methods. For argon-nucleus collisions the discrepancy between our experimental results and predictions of intranuclear cascade calculations is increasing with the mass asymmetry of the colliding system.

47781 (GSI-90-29(prepr.)) **Positron line emission in very heavy ion collisions. A status report on experimental results.** Bokemeyer, H.; Koenig, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jun 1990. 19p. (CONF-900183--: Recontres De Moriond '90: new and exotic phenomena, Les Arcs (France), 20-27 Jan 1990). Order Number DE90519760. Source: NTIS (US Sales Only), PC A03/MF A01.

This article, summarizes some of the main features of the positron lines including the recent experimental progress. This article covers results from the EPOS and ORANGE experiments and is consequently subdivided into two major parts. (orig./HSI).

47782 (INIS-mf-12691) **PSI nuclear and particle physics newsletter 1989: PSI annual report 1989 annex I.** Frosch, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Furrer, F. (eds.). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1990. 99p. Order Number DE90638849. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The present newsletter contains reports on nuclear and particle physics supported by the F1 division of PSI. Groups were invited to present new preliminary or final results obtained in 1989. As

usual there has been no refereeing. The contributions must not be quoted without previous consultation with the authors. Spokespersons are indicated by superscripts 'S' following their names in the headings of the contributions. (author) 85 figs., 10 tabs., 307 refs.

47783 (INIS-mf–12693) **PSI nuclear energy research progress report 1989: PSI annual report 1989 annex IV.** Alder, H.P. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Wiedemann, K.H. (eds.). Paul Scherrer Inst. (PSI), Villigen (Switzerland). 1989. 89p. Order Number DE90638829. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

This report gives on overview on the PSI's nuclear energy research in the field of reactor physics and systems, thermalhydraulics, materials technology and nuclear processes, waste management program and LWR safety program. It contains also papers dealing with reactor safety, high temperature materials, decontamination, radioactive waste management and materials testing. 74 figs., 20 tabs., 256 refs.

47784 (JINR-R–1-89-14) **Effects due to the time required for formation of ultrarelativistic positronium.** Nemenov, L.L. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 14p. (In Russian). Order Number DE90638850. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Effects are considered due to the time required for formation of ultrarelativistic positronium from a (e^+e^-)-pair. An estimation has been performed, for the processes $\gamma+A_Z \rightarrow A_{2e}+A_Z$ and $\pi^0 \rightarrow A_{2e} \rightarrow \gamma$, of the thickness of the layer of material L lowering the probability of positronium formation by a factor of e as the positronium energy E_A increases. The value L increases also: for platinum L_{Pt} changes from 0.7 μm to 3.5 μm for E_A=6 GeV and E_A=120 GeV, respectively. The obtained values of L_{Pt} are 100-500 times larger than layer thickness of platinum that weakens by a factor of e the beam intensity of positronia in a stationary state: $\lambda_{Pt}=7\times10^{-3}$ μm and is independent of the positronium energy. The large value of L_{Pt} makes possible the utilization of the photoproduction of positronium for generating beams of ultrarelativistic A_{2e}. The properties of atomic beams obtained with the aid of photoproduction and from the decay of π^0-mesons are discussed. Experiments are proposed which will permit detailed investigation of the formation of positronium from a (e^+e^-)-pair. 23 refs.; 4 figs.; 2 tabs.

47785 (LA–11893-T) **Measurement of the $2^2S_{1/2}$-$2^2P_{3/2}$ fine structure interval in muonium.** Kettell, S.H. Los Alamos National Lab., NM (USA). Aug 1990. 112p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. Order Number DE90016725. Source: NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

Thesis. Submitted to Yale University, New Haven, CT.

The $(2^2S_{1/2} - 2^2P_{3/2})$ fine structure transition in muonium has been observed for the first time. The measured value is $9895_{-30}{}^{+35}$MHz. This measurement, when included with the theoretical value for the $2^2P_{1/2} - 2^2P_{3/2}$ fine structure interval, gives a value for the Lamb shift $(2^2S_{1/2} - 2^2P_{1/2})$ independent of previous direct measurements. From the theoretical value for the fine structure interval, 10921.833(3) MHz, the value for the Lamb shift determined from this experiment is $1027_{-35}{}^{+30}$ MHz and is in agreement with the prediction of quantum electrodynamics (QED) of 1047.5(3) MHz. Previous experimental values for the Lamb shift $(2^2S_{1/2} - 2^2P_{1/2})$ in muonium are $1070_{-15}{}^{+12}$ MHz and $1042_{-23}{}^{+21}$ MHz. Combining this result with these previous results gives a new experimental value of $1058_{-12}{}^{+10}$ for the Lamb shift in muonium. Muonium, the bound state of two structureless leptons (μ^+e^-), is an ideal system for testing bound state QED because of the lack of hadronic structure as exists in the hydrogen system. The measurement makes use of the techniques of atomic beam microwave spectroscopy. Muonium atoms (μ^+e^-) in the 2S states are produced by the beam-foil technique at the Clinton P. Anderson Meson Physics Facility with a low momentum, sub-surface muon beam. A variable frequency microwave field is applied to drive the atoms from the 2S to the 2P states, with the subsequent observation of the Lyman alpha photon from the decay of the 2P state to the 1S ground state. The frequency is varied from 9.0–11.0 GHz, driving the F = 0 → F = 1, F = 1, F = 1 and F = 1 → F = 2 transitions.

47786 (NBI-HE–90-28) **The Barkas effect in a central collision: Exact numerical results and the 10'th order Born series.** Mikkelsen, H.H. (Odense Univ. (Denmark). Fysisk Inst.); Flyvbjerg, H. Niels Bohr Inst., Copenhagen (Denmark). Jun 1990. 32p. Order Number DE90638862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The time-dependent Schroedinger equation for a central collision between a heavy point charge and a harmonically bound electron is solved numerically. This is done in a basis of energy eigenfunctions of the undisturbed electron. Our numerical method also provides the coefficients of the Born series for the collision. We compare the Born expansion with exact results. In agreement with other calculations we find a significant Barkas effect for some collision parameter values. At low velocities the Barkas-correction is shown to be very large, but at higher velocities it becomes very small even for ions with high charges. (orig.).

47787 (ORNL/FTR–3706) **[Artificial intelligence and molecular dynamics simulations of polymers]: Foreign trip report, July 18, 1990–August 16, 1990.** Noid, D.W. Oak Ridge National Lab., TN (USA). 27 Aug 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016727. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in planning a new methodology for performing molecular dynamics simulation of polymers. Current computer polymer dynamics programs are either capable of very general calculations and are extremely inefficient or are very efficiently written for a particular computer architecture to study a specific polymer system. Both of these approaches involve tremendous efforts in FORTRAN programming. A combined effort of computer scientists and myself hope to develop an expert system to produce efficient FORTRAN codes for any polymer and be optimized on computer architectures ranging from TRANSPUTERS to CRAY. The result of this collaboration will be an efficient way to model polymer dynamics for an arbitrary polymer structure. The subsidiary purpose was to present a seminar at the University of Newcastle and discussions with several other departments at Oxford University.

47788 (PB–90-244690/XAB) **Cross sections and swarm coefficients for H^+, H^{2+}, H^{3+}, H, H_2; and H-in H_2 for energies from 0.1 eV to 10 keV. Quarterly report.** Phelps, A.V. Joint Inst. for Lab. Astrophysics, Boulder, CO (USA). ©1990. 23p. Source: NTIS(Order as PB90-244658).

Included in Jnl. of Physical and Chemical Reference Data, Vol. 19, No. 3, 653-673(1990). Available from American Chemical Society, 1155 16th St., NW, Washington, DC 20036.

Graphical and tabulated data and the associated bibliography are presented for cross sections for elastic, excitation and ionization collisions of H(1+), H2(1+), H3(1+), H, H2, and H(1-) with H2 at laboratory energies from 0.1 to 10 keV. Where appropriate, drift velocities and reaction or excitation coefficients are calculated from the cross sections and recommended for use in analyses of swarm experiments and electrical discharges. Collisions of electronically excited states with H2 are not included.

47789 (PNL-SA–17230) **Effects of in-plane π' bonding on electronic transition energies for inorganic polymers.** Ferris, K.F.; Risser, S.M.; Hanson, A.K. Pacific Northwest Lab., Richland, WA (USA). Mar 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-891119–138: Materials Research Society fall meeting, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE90017144. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The electronic structure of organic and inorganic polymeric systems are well described in terms of their molecular symmetry, even with the large bond polarity shown by such systems as polyphosphazenes. We have performed calculations using the semi-empirical CNDO/1 method to determine the valence electronic structure for a series of model phosphonitrilic and organic compounds. The optical transition energies for phosphonitrilic compounds are greater than

their organic counterparts as a result of in-plane π' bonding interactions. The extent of these interactions is modulated by the electronegativity of the substituent groups on the phosphorus atoms. We report values for the vertical ionization energy and electronic absorption wavelengths, and use molecular orbital contour analysis to show the effects of ligand electronegativity on the π' network. 15 refs., 3 tabs.

47790 (PSI–68) **Proposal for an intense slow positron beam facility at PSI: Monoenergetic, intense esup +-beams at PSI.** Waeber, W.B. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Taqqu, D.; Zimmermann, U.; Solt, G. (eds.). Paul Scherrer Inst. (PSI), Villigen (Switzerland). May 1990. 84p. Order Number DE90638869. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

In the domain of condensed matter physics and materials sciences monoenergetic slow positrons in the form of highest intensity beams are demonstrated to be extreamly useful and considered to be highly needed. This conclusion has been reached and the scientific relevance of the positron probe has been highlighted at an international workshop in November 1989 at PSI, where the state of the art and the international situation on slow positron beams, the fields of application of intense beams and the technical possibilities at PSI for installing intense positron sources have been evaluated. The participants agreed that a high intensity beam as a large-scale user facility at PSI would serve fundamental and applied research. The analysis of responses given by numerous members of a widespread positron community has revealed a large research potential in the domain of solid-state physics, atomic physics and surface, thin-film and defect physics, for example. The excellent feature of slow positron beams to be a suitable probe also for lattice defects near surfaces or interfaces has attracted the interest not only of science but also of industry.In this report we propose the installation of an intense slow positron beam facility at PSI including various beam lines of different qualities and based on the Cyclotron production of β^+ emitting source material and on a highest efficiency moderation scheme which exceeds standard moderation efficiencies by two orders of magnitude. In its proposed form, the project is estimated to be realizable in the nineties and costs will amount to between 15 and 20 MSFr. (author) 10 figs., 6 tabs., 78 refs.

6404 Fluid Physics

Refer also to citation(s) 47379, 47985

47791 (AD-A–221979/8/XAB) **Computational methods for problems in aerodynamics and large space structures using parallel and vector architectures. Final report, September 1985-February 1990.** Gottlieb, D. Brown Univ., Providence, RI (USA). Div. of Applied Mathematics. 25 Apr 1990. 16p. Grant AFOSR-85-0303. Source: NTIS, PC A03/MF A01.

The objective of our research was to design a computer code capable of simulating interactions between complicated flows and shock waves. It is possible to completely overcome the Gibbs phenomenon from the approximation (or signal processing) point of view. The main theoretical breakthrough has been the observation that the Gibbs phenomenon does not apply to moments of the approximated function. These moments are obtained with high accuracy. The only remaining difficulty is the accurate reconstruction of a given function from its moments. We have suggested and tested several different methods. Computationally the above ideas are carried out as low-pass filters. We have proved that when a discontinuous signal is being evolved in time by a linear system of hyperbolic equations, the moments are obtained with spectral accuracy. An essentially non-oscillatory spectral method is developed for the numerical simulations of non-linear equations. Cell Averages techniques are developed for Fourier and Chebyshev Spectral methods. This techniques is crucial for modern shock capturing techniques.

47792 (CTH-IEFT-PP–1990-06) **A nonlinear Lagrangian MFE method for ideal MHD.** Benda, M.; Bondeson, A; Pekkari, L.O. Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. 1990. 51p. Order Number DE90638956. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

A nonlinear moving finite element method (MFE) for ideal magnetohydrodynamics (MHD) is developed and tested. The method is based on a variational principle in Lagrangian formulation of ideal MHD. A set of various FEM discretization based on this method is investigated in terms of stability, convergence and energy conservation properties.

47793 (LA–11692-MS-Vol.3) **AFDM: An Advanced Fluid-Dynamics Model: Volume 3: AFDM heat-transfer and momentum-exchange coefficients.** Berthier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)); Wilhelm, D.; Bohl, W.R. Los Alamos National Lab., NM (USA). Sep 1990. 85p. Sponsored by U.S. Department of Defense; Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order Number DE90017537. Source: NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report consists of three parts. First, for the standard Advanced Fluid-Dynamics Model (AFDM), heat-transfer coefficients between components are worked out, depending on the different possible topologies. Conduction, convection, and radiative heat-transfer mechanisms are modeled. For solid particles, discontinuous phases that obey a "rigid" model, and components lacking relative motion, heat transfer is by conduction. Convection is represented for fluids in motion inside "circulating" bubbles and/or droplets. Radiation is considered between droplets in vapor continuous flow. In addition, a film-boiling model has been formulated, where radiation provides the lower limit on the fuel-to-coolant heat-transfer coefficient. Second, the momentum-exchange coefficients are defined for the standard AFDM. Between a continuous and discontinuous phase, the model consists of both laminar and turbulent terms. The most important feature is the drag coefficient in the turbulent term. It is calculated by a drag similarity hypothesis with limits for large Reynolds numbers, distorted "particles," and churn-turbulent flow. A unique hysteresis algorithm exists to treat the liquid continuous to vapor continuous transition. Two discontinuous components are coupled using a turbulent term with an input drag coefficient. Fluid- structure momentum exchange is represented with a standard friction-factor correlation. Third, the formulas used for the AFDM simplified Step 1 models are discussed. These include the heat-transfer coefficients, the momentum-exchange functions, and the manner in which interfacial areas are determined from input length scales. The simplified modeling uses steady-state engineering correlations, as in SIMMER-II.

47794 (LA–11692-MS-Vol.4) **AFDM: An Advanced Fluid-Dynamics Model: Volume 4, The AFDM heat- and mass-transfer solution algorithm.** Bohl, W.R.; Berthier, J.; Goutagny, L.; Schmuck, P. Los Alamos National Lab., NM (USA). Sep 1990. 46p. Sponsored by U.S. Department of Defense; Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order Number DE90017535. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report gives the Advanced Fluid-Dynamics Model (AFDM) solution algorithm describing vaporization/condensation (V/C) and melting/freezing processes. The finite-difference equations used are derived from the general AFDM differential equations with convection ignored. In two-phase cells, V/C is determined by a simultaneous iterative solution. The objective is to retain stability and energy conservation with consistent interfacial and bulk conditions describing vapor/liquid densities and temperatures. Particular attention is given in the special cases required to obtain a solution. In single-phase cells, the heat transfer is determined first; then, a vapor composition is updated for the α_0 volume based on the saturation pressures for the individual liquids. Melting/freezing rates are determined based on equilibrium considerations. Mass-transfer-induced velocity changes are calculated implicitly so as to conserve momentum. In addition to the treatment of the standard models, a description is provided on the energy transfers used for the simplified NOPHASE option.

47795 (LA–11692-MS-Vol.5) **AFDM: An Advanced Fluid-Dynamics Model: Volume 5: The convective transport algorithm.** Bohl, W.R. Los Alamos National Lab., NM (USA). Sep 1990. 127p. Sponsored by U.S. Department of Defense; Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order

Number DE90017536. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report gives the details for the convection of mass, momentum, and energy in the Advanced Fluid-Dynamics Model (AFDM) code. Steps 2–4 of the AFDM algorithm are described. Step 2 explicitly convects the results of Step 1 intracell transfers. Step 3 performs an iteration to obtain consistent end-of-time-step cell-edge velocities and cell-centered pressures. Step 4 convects all cell variables with converged Step 3 velocities and includes the effects of interfacial dissipation. The unique AFDM higher-order spatial differencing format and the iterative solution for velocities based on three-field momentum coupling coefficients are described. The rationale for the momentum convection relationships selected is discussed. Details are provided on the linear equation-solver options available to treat the five-diagonal pressure-coefficient matrix formulated in the Step 3 iteration. 34 refs.

47796 (LA–11692-MS-Vol.7) **AFDM: An Advanced Fluid-Dynamics Model: Volume 7, The AFDM code user's manual.** Parker, F.R.; Bohl, W.R.; Henninger, R.J. Los Alamos National Lab., NM (USA). Sep 1990. 202p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order Number DE90017539. Source: NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The Advanced Fluid-Dynamics Model (AFDM) computer code is designed to test advanced fluid-dynamics models. The programming objectives in writing AFDM were (1) to produce a code in which all computational loops were vectorized and (2) to produce an exportable code. To accomplish these objectives, we used gather/scatter and vector-merge techniques and shorter, more managable DO loops. We also reduced the number of DO loops over a computational mesh to one. The disadvantage of having only one DO loop was the need to recalculate a small set of boundary cells. The gather/scatter process divides the computational mesh into classes such as two-phase and single-phase cells. The scattered data then are gathered, the computation is executed by a high-speed vectorized loop, and the results are scattered again. Vector merges use a truth vector to choose the needed results; however, all results for both sides of the truth vector must be calculated. A small test code using these features shows efficiency improvements of a factor of 5 to 10 over nonvectorized codes. The AFDM input is completely free form. The variables were divided into classes, and each variable was given a unique name in that class to allow the input deck to be edited by a variable name. The AFDM output can be text or plot output. The text output goes to printers and will not include plots. The plot output goes to a plotting medium that also can include the text.

47797 (LA–11692-MS-Vol.8) **AFDM: An Advanced Fluid-Dynamics Model: Volume 8, The T6P postprocessor manual.** Parker, F.R. Los Alamos National Lab., NM (USA). Sep 1990. 133p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. Order Number DE90017538. Source: NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The T6P postprocessor analyzes data from TAPE6 and TAPE36. The processor calculates new variables, integrates variables over regions of the mesh, compares values of a variable of a given problem at selected times, compares values of a variable at selected times between problems for parameter studies, calculates derivatives of a variable with respect to time or another variable, and traces a variable at a requested location in the mesh over time. The data are presented to the user graphically, using two-dimesnional graphs and three-dimensional perspective or contour plots. Interactive graphic techniques may be used with perspective plots.

47798 (LA-UR–90-2743) **Transport of a passive tracer in time-dependent Rayleigh-Benard convection.** Camassa, R.; Wiggins, S. Los Alamos National Lab., NM (USA). [1990]. 22p. Sponsored by U.S. Department of Defense; U.S. DOE Office of Administration and Human Resource Management; National Science Foundation. DOE Contract W-7405-ENG-36. AFOSR DPP 8968. (CONF-9005237–5: 10. annual conference on nonlinear science: the next decade, Los Alamos, NM (USA), 21-25 May 1990). Order Number DE90016507. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The transport of a passive tracer in a Rayleigh-Benard cell is considered, when the convection rolls are subject to oscillatory instability. We propose a mechanism for the roll to roll transport and introduce formulae for quantifying the spreading of the tracer, which are valid for as long as the molecular diffusivity can be neglected. A criterion for weighing the effects of diffusivity is discussed, and we provide some example by numerically simulating the flow in presence of molecular diffusivity. 8 refs., 6 figs.

47799 (LA-UR–90-2744) **Stability of some stationary solutions for the forced KdV equation.** Camassa, R. (Los Alamos National Lab., NM (USA)); Yao-tsu Wu, T. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research; National Science Foundation. DOE Contract W-7405-ENG-36. Contract ONR N00014-89-J1971;Grant 4 DMS-890 1440;AFOSR DPP 8968 (CONF-9005237–4: 10. annual conference on nonlinear science: the next decade, Los Alamos, NM (USA), 21-25 May 1990). Order Number DE90016506. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The forced KdV (fKdV) equation has been established by recent studies as a simple mathematical model capable of describing the physics of a shallow layer of fluid subject to external forcing. For a particular one-parameter family of forcings which is characterized by a wave amplitude parameter for supercritical forcing distributions, exact stationary solutions are known. We study the stability of these solutions as the parameter varies. The linear stability analysis is first carried out, and we discuss the structure of the spectrum of the associated eigenvalue problem using a perturbation approach, about isolated parameter values where eigenfunctions can be expressed in closed form and are the fixed-point solutions of the fKdV equation corresponding to zero eigenvalues. The results identify a set of intervals in the parameter space corresponding to different types of manifestation of instability. In the region of the parameter space where the linear stability analysis fails to provide an answer, we have developed a nonlinear analysis to provide a sufficient condition for stability. 13 refs.

6450 High Energy Physics

Refer also to citation(s) 47865

47800 (DOE/ER/05096–41) **High energy: Progress report, March 1, 1990–February 28, 1991.** Bonner, B.E.; Roberts, J.B. Jr. Rice Univ., Houston, TX (USA). Bonner Nuclear Labs. 1 Sep 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-76ER05096. Order Number DE90017281. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We report here on the considerable progress that we made for the year beginning November 1, 1989, for DOE Contract No. AS05-76ERO5096. One of our Fermilab experiments, E704 – polarization studies with 200 GeV protons, was run from February through August of this year. This experiment has been in the planning, construction, and commissioning stages for over ten years. In this report we detail just what measurements we managed to complete during the run. Our other Fermilab experiment, E683 – photoproduction of jets, has had parasitic test beam during most of the same period. There was also a one week engineering test run in June. The schedule calls for a three month data run beginning in January, 1991. We also had three test runs for our CERN experiment, NA47 (SMC) – spin dependent structure functions for the proton and neutron. We are in the midst of major apparatus construction for this experiment. More of our plans for the future are included in the accompanying Renewal Proposal. As in recent years, the format we follow in both the Progress Report and the Renewal Proposal is to have a brief writeup on each individual experiment and to include in the appendices copies of published papers which provide much greater detail. For manuscripts that have been submitted for publication and experimental proposals, we provide only the cover and abstract page. The aim is to concentrate on the physics goals, results and their significance in the main body of the report. For our two Fermilab experiments and the SMC experiment, exhaustive reports of the physics goals have been provided in previous years and are not repeated here.

47801 (DOE/ER/05490–123) **Research in elementary particle physics: Progress report, March 1, 1990–February 28, 1991.** Chan, Lai-Him; Haymaker, R.; Imlay, R.; McNeil, R.; Metcalf, W. Louisiana State Univ., Baton Rouge, LA (USA). [1991]. 112p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-77ER05490. Order Number DE90017278. Source: NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

We describe theoretical work on effective action expansion of an effective low energy theory of hadrons, dynamical symmetry breaking, and lattice gauge theories. The high energy experimental group at Louisiana State University finished taking data on a neutrino oscillation experiment at LAMPF in 1989 and expects to complete the data analysis soon. LSU is also participating on an electron-positron experiment, AMY, that is running at TRISTAN in Japan. We plan to leave as of March 1, 1990 to concentrate on ZEUS and SSC activities. For ZEUS we are presently building the EMC waveshifters for the barrel calorimeter and participating on the calorimeter beam tests at Fermilab.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 47434, 47762, 47840, 47849, 47866, 47871, 47885, 47888

47802 (BNL–44931) **Baryon spectra in the low p_T-region.** Bellwied, R. E814 Collaboration. Brookhaven National Lab., Upton, NY (USA). [1990]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900331–14: Workshop on heavy ion physics at the alternating gradient synchrotron, Upton, NY (USA), 3-7 Mar 1990). Order Number DE90016290. Source: NTIS, PC A03/MF A01; OSTI; INIS.

The measurement of transverse momentum spectra for identified particle species in central collisions of relativistic heavy ions is of great interest for the determination of parameters which describe the phase of high density matter presumably formed in these collisions. If thermal equilibrium is reached in a heavy ion collision, then the transverse momentum distribution of the emitted particles is related to the freeze-out temperature T of the particle species under consideration. For a single source Boltzmann-distribution T would be obtained by fitting a distribution of the form $A\, m_T \exp(-m_T/T)$ to the measured transverse momentum spectrum, where $m_T=\sqrt{m_0^2 + p_T^2}$. An impressive sample of p_T-spectra for different identified particles was recently measured at the AGS by the E802-group. The distributions of invariant cross sections for all measured particle species are in agreement with a Boltzmann-distribution as well as with an exponential distribution in the transverse mass m_T. More interesting features of relativistic heavy ion collisions are possibly hidden in the very low p_T-range. The measurements at 200 GeV/u at CERN revealed for π-spectra a deviation from the exponential slope, the so called 'low p_T-enhancement,' below p_T = 200 MeV/c. Many speculations about the origin of this phenomenon arose from these measurements down to very low values of p_T. In this context it is therefore very interesting to measure spectra of nucleons in the same low p_T region and search for similar enhancements. This paper discusses the search for these enhancements.

47803 (CONF-900822–7) **Measurements of heavy quark fragmentation at TRISTAN.** The AMY Collaboration. Louisiana State Univ., Baton Rouge, LA (USA). [1990]. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-77ER05490. From 25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990. Order Number DE90017405. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The momentum spectrum of muons contained in multihadron e^+e^- annihilation events at an average center-of-mass energy $\sqrt{s}$ = 57.3 GeV is used to study the fragmentation functions for heavy quarks. We obtain average values for the fragmentation variable, $x_E = E_{hadron}/E_{beam}$ for the b- and c-quark of $\langle x_E \rangle_b$ = 0.77 (+0.12/−0.11) and $\langle x_E \rangle_c$ = 0.57 (+0.08/−0.10), respectively.

47804 (DOE/ER/05490–110) **High precision study of the space distribution of the colour flux in the SU(2) lattice gauge theory.** Haymaker, R.W. (Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Physics and Astronomy); Peng, Yingcai; Singh, Vandana; Wosiek, J. Louisiana State Univ., Baton Rouge, LA (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-77ER05490. (CONF-8909249–14: Lattice '89: symposium on lattice field theory, Capri (Italy), 18-21 Sep 1989). Order Number DE90017406. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The work of the Cracow-LSU collaboration on the space structure of the color fields around the static charges is reported. We find that the large cancellations between the electric and magnetic energy densities lead to a narrow tube.

47805 (DOE/ER/40143–7) **Theoretical studies in few-body intermediate energy physics: Progress report, November 1, 1989–August 31, 1990.** Mizutani, T. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Aug 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-84ER40143. Order Number DE90017279. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper discusses: $pp \rightarrow \pi^+np$ reactions at T_{lab}^p = 800 MeV; $NN \rightarrow N\Delta$ reactions; $N\Delta$ phase shifts; and low energy elastic K^-d scattering. (LSP)

47806 (FNAL/C–90/151) **Dijet spectroscopy at high luminosity.** Green, D. Fermi National Accelerator Lab., Batavia, IL (USA). Jul 1990. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9006267–1: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE90016901. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A study of the dijet mass resolution has been made appropriate to high luminosity operation. As a benchmark, the mass resolution of $W \rightarrow jj$ for a Higgs boson of 800 GeV has been optimized for no, eight, and sixteen overlapping minbias events. A factor of 2.5 degradation in M_{jj} width is seen. 6 refs., 10 figs.

47807 (FNAL/C–90/155) **A global analysis of recent experimental results: How well determined are the parton distribution functions?.** Morfin, J.G. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1990. 32p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9004112–4: Workshop on hadron structure functions and parton distributions, Batavia, IL (USA), 26-28 Apr 1990). Order Number DE90016902. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Following is a brief summary of the results of an analysis of experimental data performed to extract the patron distribution functions. In contrast to other global analyses, this study investigated how the fit results depend on: Experimental Systematic Errors; Kinematic Cuts on the Analyzed Data and Choice of Initial Functional Forms, with a prime goal being a close look at the range of low-x behavior allowed by data. This is crucial for predictions for the SSC/LHC, HERA, and even at Tevatron Collider energies. Since all details can be found in the just released Fermilab preprint Parton Distributions from a Global QCD Analysis of Deep Inelastic Scattering and Lepton-Pair Production by J. G. M. and Wu-Ki Tung, this summary will be only a brief outline of major results. 11 refs., 13 figs.

47808 (FNAL/C–90/160-E) **Total, elastic and diffractive cross sections at high energies.** Rubinstein, R. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1990. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9006268–1: 10. international conference on physics in collision, Durham, NC (USA), 21-23 Jun 1990; E–710). Order Number DE90017264. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The status of hadron-hadron total, elastic and diffractive scattering is discussed, including recent data from Fermilab experiment E-710. 15 refs., 24 figs.

47809 (INP–1447/PH) **Observation of associated beauty production and decay in high energy hadron interaction.** Wilczynska, B. (Institute of Nuclear Physics, Cracow (Poland)); Wilczynski, H.; Holynski, R. JACEE Collaboration. Institute of Nuclear Physics, Cracow (Poland). Apr 1989. 24p. Order Number DE90639179. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Production and decay of a pair of beauty mesons are observed in the JACEE emulsion chamber. Analysis of the event leads to an indication that one of the B mesons decays via weak b→u transition, suppressed in the Standard Model. Consequently, the Kobayashi-Maskawa matrix element V_{ub} must be different from zero. 9 refs., 7 figs., 3 tabs. (author).

47810 (LA-UR-90-2690) **Neutrino properties and puzzles.** Bowles, T.J. Los Alamos National Lab., NM (USA). [1990]. 13p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-900601–7: 12. international conference on particles and nuclei, Cambridge, MA (USA), 24-29 Jun 1990). Order Number DE90016569. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Sixty years after the existence of the neutrino was first postulated, we are still lacking in information on the fundamental properties of neutrinos. Measurements have consistently pushed the limits on the mass, magnetic moment, and possible mixing down. Solar neutrino experiments are now shedding more light on the "solar neutrino problem" and are starting to give a hint that perhaps these quantities are nonzero. The present status of our knowledge of neutrino properties, the newest experimental data on the "solar neutrino problem," and future plans will be presented. 27 refs.

47811 (OUP-90-12) **Results of the DELPHI collaboration from hadronic decays of the Z^0 boson.** Dam, M. (European Organization for Nuclear Research, Geneva (Switzerland)). DELPHI collaboration. Oslo Univ. (Norway). Fysisk Inst. May 1990. 12p. Order Number DE90639169. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In 1989 the DELPHI detector at LEP collected around 11100 hadronic Z^0 decays. Based on these data results are presented from studies of general properties of hadronic decays of the Z^0 boson, and on a precise measurement of the Z^0 resonance parameters. 12 refs., 4 figs., 2 tabs.

47812 (SLAC-369) **Strangeonium spectroscopy at 11 GeV/c and Cherenkov Ring Imaging at the SLD.** Bienz, T.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1990. 256p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE90018003. Source: NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.

This thesis is divided into two sections, which describe portions of the data acquisition system and online software for the Cherenkov Ring Imaging Detector (CRID) for the SLD, and analyses of several low cross section strangeonium channels in data from the LASS spectrometer. The CRID section includes a description of the data acquisition system, determination of the preamplifier gain, and development of an online pulse finding algorithm based on deconvolution. Deconvolution uses knowledge of the preamplifier impulse response to aid in pulse finding. The algorithm is fast and shows good single pulse resolution and excellent double pulse resolution in preliminary tests. The strangeonium analyses are based on data from a 4.1 event/nanobarn exposure of the LASS spectrometer in K^-p interactions at 11 GeV/c, and include studies of $\Lambda\eta\pi^+\pi^-$, ΛK^+K^-, and $\Lambda\phi\phi$.

47813 (UIUC-HEPG-90-58) **Physics at a Tau Charm Factory.** Izen, J.M. Illinois Univ., Urbana, IL (USA). Dept. of Physics. [1990]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01195. (CONF-900193–6: Division of particle, Houston, TX (USA), 2 Jan 1990). Order Number DE90016732. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A high luminosity $e + e -$ collider is proposed to explore decays of charmed D and D_s mesons, τ leptons, and charmonia. A brief description of the accelerator and detector design is given, followed by a discussion of selected experiments in D and τ physics. 14 refs., 13 figs., 4 tabs.

47814 (UIUC-HEPG-90-63) **Measurement of the mass and width of the Z boson from $Z \rightarrow e^+e^-$ decay in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.8 TeV.** Keutelian, H. Illinois Univ., Urbana, IL (USA). Dept. of Physics. May 1990. 94p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01195. Order Number DE90016791. Source: NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

I report the results of an analysis to measure the mass and width of the Z gauge boson from $Z \rightarrow e^+e^-$ decays in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.8 TeV. The $Z \rightarrow e^+e^-$ data from the CDF detector yields a mass of the Z boson of $M_Z = 90.78 \pm 0.40(\text{stat.}) \pm 0.38(\text{syst.}) \pm 0.2(\text{scale})$ GeV/c^2 and a width of $\Gamma_Z = 2.8 \pm 1.0(\text{stat.}) \pm 0.5(\text{syst.})$ GeV. 38 refs., 49 figs., 4 tabs.

47815 (UIUC-HEPG-90-65) **Semileptonic charm decay at a Tau Charm Factory.** Izen, J.M. Illinois Univ., Urbana, IL (USA). Dept. of Physics. [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01195. (CONF-8905144–18: Tau-Charm Factory workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE90016790. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The full spectrum of $D_{\ell 3}$ and $D_{\mu 4}$ semileptonic decays can be precisely measured at a Tau Charm Factory. Sensitivity to rare semileptonic decays extends to branching fractions as small as 10^{-3}. Improved measurements of Cabibbo-Kobayashi-Maskawa matrix elements V_{cs} and V_{cd} can be obtained. With an improved theoretical understanding, semileptonic measurements can test the unitarity of the second row of the Cabibbo-Kobayashi-Maskawa matrix at the 1% level. 10 refs., 4 figs., 1 tab.

47816 **Top search progress in CDF.** Yeh, G.P. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1-19 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discussed the Tevatron Collider and CDF. The author expects to see $e\mu$ events from $t - t$ decays, for top quark mass in the 30 to 60 GeV region and observes zero candidates. CDF is taking data at the rate of about 0.2 pb^{-1} per week, with a total integrated luminosity of 5 pb^{-1} expected for this run. The e + jets and the $e\mu$ analyses, which will be complemented by on-going analyses such as ee and μ + jets that are feasible in CDF, can soon probe the top quark with mass up to 100 GeV.

47817 **Search for long-lived, strongly produced heavy particles in $p\bar{p}$ collisions at square root s = 630 GeV.** Kroll, I.J. (Chicago Univ., IL (USA). Enrico Fermi Inst.). pp. 39-51 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper presents a search for a long-lived (– 10 seconds), strongly produced heavy particle. The search uses data from proton-antiproton collisions at square root s = 630 GeV recorded by the UA1 detector at CERN. The search focuses on the possibility of a long-lived, heavy quark; an particular model is studied: that of a charge - 1/3 quark (referred to as the b′ quark) that decays predominantly to the c quark. The mass range considered is $m' >$ 20 GeV/C^2. Results of the search are given.

47818 **CP violation in K decays.** Gilman, F.J. (Stanford Univ., CA (USA)). pp. 171-181 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper reviews recent theoretical and experimental progress on the manifestation of CP violation in K decays, and toward understanding whether CP violation originates in a phase, or phases, in the weak mixing matrix of quarks.

47819 **A progress report of Fermilab experiment E-731: A precision experiment to measure epsilonprime/epsilon and rare decay modes of the neutral kao.** Wah, Y.W. (Chicago Univ., IL (USA). Enrico Fermi Inst.). pp. 162-170 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences,

New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses the $K_L \rightarrow {}^0e^+e^-$ decay mode that provides a test of Standard Model, and offers an attractive alternative to explore CP violation which is a central issue in elementary particle physics. According to the author, many other interesting decay modes which are also within the experimental reach of the proposed experiment, besides providing a stimulating physics playground, also serves as calibration at different sensitivity level.

47820 **Fixed-target hadroproduction of beauty: In Fermilab experiment E771 and at the SSC.** Cox, B. (Virginia Univ., Charlottesville, VA (USA)). pp. 224-236 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses the high mass of the B hadrons that makes possible very discriminating trigger strategies in present fixed-target experiments at Fermilab. The open geometry experiment E771 uses the presence of high p_t single muons and high mass muon pairs as a signature of B decays for constructing a trigger system that will approach rejection factors for total cross-section events of a few x 10 –5. According to the author these techniques are directly extendible to experiments using a 20 TeV peeled proton beam facility at the SSC committed to B physics. The low intensity of protons required for B physics makes possible the concurrent operation of such a facility with the SSC collider program. The increase of B production cross-section by a factor of 250 relative to the Fermilab TeV II makes possible the production of 10^{10} - 10^{11} high-momentum B's in a relatively clean (compared to hadron collider experiments) experimental environment.

47821 **Search for the rare decay K→ν.** Atiya, M.S. (Brookhaven National Lab., Upton, NY (USA)); Chiang, I.H.; Frank, J.S.; Haggerty, J.S.; Ito, M.M.; Kycia, T.F.; Li, K.K.; Littenberg, L.S.; Sambamurti, A.K.; Stevens, A.J.; Strand, R.C.; Louis, W.C.; Akerib, D.S.; Marlow, D.R.; Myers, P.D. pp. 202-214 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses the rare decay $K^+ \rightarrow \bar{\nu}$ in the context of the three-generation Standard Model, before turning to possible extensions, such as the addition of a fourth generation of fermions. The apparatus of designed to search for this decay, and the status of the analysis of data from its first run are described. Preliminary results on the reactions $K^+ \rightarrow {}^+ -$ and ${}^0 \rightarrow {}^\nu$ are also given.

47822 **Prospects for beauty physics at hadron colliders.** McDonald, K.T. (Princeton Univ., NJ (USA). Joseph Henry Labs.). pp. 215-223 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses the cross-section for gg → BB which is relatively high at collider energies, so that a one-year run at RHIC or TEV I might yield ^{10} B-$\bar{B}$ pairs, and > 10^{12} pairs at the SSC. The challenge to the experimenter is to trigger on and reconstruct a significant fraction of this sample. Detectors are being proposed that make extensive use of silicon vertexing, VLSI readout, and massive online numerical processing with the goal of maintaining a 1% efficiency for few-body decays to all-charged final states.

47823 **Measuring the mass and width of the Z^0: The status of the energy spectrometers.** Rouse, F. (Lawrence Berkeley Lab., CA (USA)); Levi, M.; Kent, J.; King, M.; Von Zanthier, C.; Watson, S.; Bambade, P.; Wormser, G.; Erickson, R.; Jung, C.K.; Nash, J. pp. 479-490 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). DOE Contract AC03-76SF00515. (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discussed the Stanford Linear Collider (SLC) that collides electrons and positrons produced in the linear accelerator pulse by pulse. The object is to produce collisions energetic enough to produce the heavy intermediate vector boson, the Z^0. An essential component of the SLC physics program is the precise knowledge of the center-of-mass energy of each interaction. The authors measure the energy of each collision by using two energy spectrometers. The spectrometers are located in extraction lines of each beam. The authors measure the energy of each beam to 20 MeV or 5 parts in 10^4 and report on the status of the energy spectrometer system.

47824 **Limits on fractionally charged particle production from cosmic rays and accelerators: How near zero.** Freedman, S.J. (Argonne National Lab., IL (USA). Physics Div.); Napolitano, J. pp. 500-510 of Near zero: New frontiers of physics. Fairbank, J.D.; Deaver, B.S. Jr.; Everitt, C.W.F.; Michelson, P.F. W. H. Freeman and Company, New York, NY (USA) (1988).

It is important to improve experimental sensitivities whenever possible, but it is even more important to investigate untested mechanisms for quark production. This paper addresses this last approach. The authors discuss recent experiments that have attempted to find quarks that may have escaped detection in previous searches. After a brief introduction to the most common experimental method, the authors discuss recent developments in the hung for fractionally charged particles in cosmic rays and accelerators.

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 47760, 47761, 47762, 47765, 47804, 47810, 47813, 47815, 47863, 47864, 47885, 47892

47825 (DOE/ER/40380–2, pp. 227-281) **Relativistic methods for few-body systems.** Gross, F. (College of William and Mary, Williamsburg, VA (USA)). Hampton Univ., VA (USA). Dept. of Physics. [1989]. (CONF-8905332–: 4. Hampton University graduate studies (HUGS) at the continuous electron beam accelerator facility (CEBAF), Hampton, VA (USA), 30 May - 17 jun 1989). In *HUGS at CEBAF: Proceedings of the Hampton University Graduate Studies at the Continuous Electron Beam Accelerator Facility*. Order Number DE90013957. Source: NTIS, PC A15/MF A01.

In the first section, the author describes how two types of relativistic two-particle quantum mechanical equations are derived. For simplicity, all particles will have spin zero, and to make comparison with one-body equations later, the Klein-Gordon equation for a single spinless particle will be presented first. In the second section these ideas are applied to spin 1/2 particles, NN scattering and the deuteron bound state. Fitting the NN scattering data and the deuteron bound state parameters can be regarded as a necessary calibration of any nuclear force model. The goal in nuclear physics is to use the same model to explain a large variety of phenomena. In the last section, the author will discuss applications of these ideas to proton -^{40}Ca scattering, 3N problems, and electromagnetic interactions of the deuterons. The unifying theme here is that particles which are spectators to an interaction are restricted to their mass shell. 18 refs., 28 figs.

47826 (INP–1436/PH) **Semihard QCD.** Kwiecinski, J. Institute of Nuclear Physics, Cracow (Poland). 1989. 30p. Order Number DE90639158. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Recent results concerning the small x limit of parton distributions in perturbative QCD are reviewed. This includes in particular discussion of the bare Pomeron in perturbative QCD and of shadowing corrections. The minijet production processes and possible manifestation of semihard interactions in high energy pp-bar elastic scattering are also discussed. 46 refs., 8 figs. (author).

47827 (INP–1439/PH) **Axial structure of the nucleon in a three-flavor chiral quark-meson model.** Broniowski, W. Institute

of Nuclear Physics, Cracow (Poland). Feb 1989. 24p. Order Number DE90639159. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Nucleon matrix elements of the 0, 3 and 8 flavor components of the axial current are calculated in an $SU(3)_L \times SU(3)_R$ chiral quark-meson model. An extension of the Gell-Mann-Levy lagrangian with effects of meson mixing is used. The cranking projection method is applied. The results are consistent with the recent EMC experiment, reinterpreted by taking into account non-perturbative effects. In particular, I find a sizable value of the flavor singlet axial current matrix element and a negligible contribution of the ss-bar components. 36 refs., 3 figs., 3 tabs. (author).

47828 (JINR-E-2-89-65) **A microscopic description of the S-wave πN-scattering lengths and the ($p\pi^-$)-atom lifetime in the quark confinement model.** Efimov, G.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Ivanov, M.A.; Lyubovitskij, V.E.; Rusetskij, A.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 18p. Order Number DE90639136. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The S-wave πN-scattering lengths and the ($p\pi^-$)-atom lifetime are in the quark confinement model. Nucleon is treated as a quark-diquark system. The fulfillment of the Weinberg-Tomozawa relations is checked. The agreement is achieved with the experiment and with the results obtained within other approaches. 32 refs.; 5 figs.; 2 tabs.

47829 (JINR-E-2-89-144) **Hadronic part of the muon anomalous magnetic moment: an improved evaluation.** Martinovic, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Dubnicka, S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 18p. Order Number DE90639103. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A new evaluation of the lowest-order hadronic vacuum-polarization contribution a_μ^{vac} to the anomalous magnetic moment of the muon with the result $a_\mu^{vac}=(7058\pm68)\times10^{-11}$ is calculated. The total error is reduced almost twice in comparison with the previous most precise evaluation. The improvement comes from the use of global analytic models of the pion and kaon form factors for the two-pion and two-kaon contributions as well as from the new experimental information mainly for the three-pion channel. The high-energy contribution to a_μ^{vac} calculated from the QCD expression for $R=\sigma(e^+e^-\to\text{hadrons})/\sigma(e^+e^-\to\mu^+\mu^-)$ is found to be consistent with the calculation based on the experimental data only after the inclusion of the third-order correction for R. 26 refs.; 1 fig.; 2 tabs.

47830 (JINR-R-2-89-217) **Superstring Z' bozon in $e^-e^+ \to f\bar{f}$-bar annihilation.** Abdullaev, S.K. (Azerbajdzhanskij Gosudarstvennyj Univ., Baku (USSR)); Mukhtarov, A.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 15p. (In Russian). Order Number DE90639124. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An influence of an additional neutral Z' bozon on characteristics of $e^-e^+\to f\bar{f}$-bar processes is studied, where ff-bar is a pair of arbitrary particles (leptons, nucleons, hyperons, pseudoscalar or vector mesons etc.). The general expression for the differential cross sections of $e^-e^+\to f\bar{f}$-bar processes is obtained with arbitrary polarizations of an electron-positron pair by introducing of structure functions, and the following integral characteristics are considered: polarized forward $A_F(\lambda_2)$ and backward $A_B(\lambda_2)$ assymmetries; right-left asymmetry A_{RL}; forward-backward asymmetry in the case of longitudinal polarized e^-e^+ pair annihilation $A_{BH}(\lambda_2)$; transversal spin assymmetries $A_\Phi^{(1)}$ and $A_\Phi^{(2)}$; the degree of longitudinal polarization of r lepton P in $e^-e^+ \to r^-r^+r^-r^+$ process. The general expressions for these characteristics are found and their quantitative estimates are given in the framework of superstring E_6-model. 20 refs.; 5 figs.; 2 tabs.

47831 (OUP-90-06) **Direct CP violation in K L , S → 2γ for large top mass.** Eeg, J.O. (Oslo Univ. (Norway). Fysisk Inst.); Nizic, B.; Picek, I. Oslo Univ. (Norway). Fysisk Inst. Mar 1990. 12p. Order Number DE90639104. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Short-distance contributions to K°(anti K°) → γγ within the standard model for large m t, including QCD corrections, have been studied. Owing to a relaxed GIM suppression, CP violation in the decay amplitude turns out to be more important than previously presumed, namely of order 100 times the direct CP violation(ϵ') in the K L → ππ decays. This promotes the rare K L , S → γγ decay modes at LEAR and Φ factories as the next possible candidates for testing direct CP violation. 26 refs., 2 figs.

47832 (SINS–2075/P-8/PH/A) **Interacting gluon model for hadronic and nuclear collisions.** Wilk, G. Institute for Nuclear Studies, Otwock-Swierk (Poland). Mar 1989. 74p. Order Number DE90639137. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Interacting gluon model providing a dynamical input for statistical models of strong interactions is formulated both for hadronic and nuclear collisions. It gives also its own independent predictions for such observables as inelasticity distributions, leading particle spectra and energy density distributions. They are calculated and compared with existing data. Both analytical and purely numerical versions of the model are presented and discussed. 96 refs., 16 figs., 7 tabs. (author).

47833 (SLAC-PUB–5312) **Bound-state quark and gluon contributions to structure functions in QCD.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1990. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9005264–2: DESY topical meeting: small-x behavior of deep inelastic structure functions in QCD, Hamburg (Germany, F.R.), 14-16 May 1990). Order Number DE90016678. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

One can distinguish two types of contributions to the quark and gluon structure functions of hadrons in quantum chromodynamics: "intrinsic" contributions, which are due to the direct scattering on the bound-state constituents, and "extrinsic" contributions, which are derived from particles created in the collision. In this talk, I discussed several aspects of deep inelastic structure functions in which the bound-state structure of the proton plays a crucial role: the properties of the intrinsic gluon distribution associated with the proton bound-state wavefunction; the separation of the quark structure function of the proton onto intrinsic "bound-valence" and extrinsic "non-valence" components which takes into account the Pauli principle; the properties and identification of intrinsic heavy quark structure functions; and a theory of shadowing and anti-shadowing of nuclear structure functions, directly related to quark-nucleon interactions and the gluon saturation phenomenon. 49 refs., 5 figs.

47834 (SLAC-PUB–5313) **Conference summary: Quantum chromodynamics at small x.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9005264–1: DESY topical meeting: small-x behavior of deep inelastic structure functions in QCD, Hamburg (Germany, F.R.), 14-16 May 1990). Order Number DE90016683. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The range of electroproduction kinematics $x_{Bj} = Q^2/(2p \cdot q) \geq 10^{-4}$ at $Q^2 \geq 10$ GeV^2 accessible at the HERA e – p collider will provide a challenging high energy testing ground for quantum chromodynamics in a regime where the gluon distribution of the proton is expected to saturate and new types of multi-scattering higher twist contributions to structure functions become important. In this summary I give a brief overview of the recent theoretical work presented at the Hamburg conference. 19 refs., 2 figs.

47835 (UM-P–89/51) **QCD corrections to the weak interactions of mesons in the static cavity.** Hollenberg, L.C.L.; McKellar, B.H.J. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 65p. (OZ–89/15). Order Number DE90639105. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The effect of QCD loop corrections to the weak interactions of hadrons is studied in a non-perturbative framework in which the matrix elements of the bare effective weak Hamiltonian between hadronic states are computed. The QCD renormalisation is carried

out in the static cavity alleviating the scale matching problem of the standard short distance analysis. Specifically, the $\Delta I=1/2$ rule was studied by computing the QCD corrected K-π matrix elements. The modified static cavity model used is characterised by four parameters; the effective quark-gluon coupling constant, the confinement pressure, the zero-point energy and a parameter governing the centre-of-mass corrections. These parameters are fitted to the π and ρ masses and the charge radii of π and K. Results are given for the ultra-relativistic ($m_u=m_d=0$) sector and for a region ($m_u=m_d\approx140$ MeV) where the $\Delta I=1/2$ rule is uniquely reproduced. 17 refs., 19 figs., tabs.

47836 (UM-P–89/58) **Radiative generation of quark and lepton mass hierarchies from a top-quark mass seed.** He Xiao-Gang (Melbourne Univ., Parkville (Australia). School of Physics); Volkas, R.R.; Wu Dandi. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 26p. (OZ-P–89/21). Order Number DE90639160. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The possibility that of all the fermions in the Standard Model only the top quark gains mass at tree-level is investigated. Quark and lepton mass hierarchies are introduced by inducing the other fermion masses at various orders of perturbation theory. Lepton and baryon number conserving scalar diquarks and leptoquarks are invoked to carry out these radiative corrections. It is shown that the simplest model has the cascade: tree-level: top; 1-loop: bottom; 2-loop: charm, tau; 3-loop: strange, mu, up, down; 4-loop: electron. Neutrinos are strictly massless because we do not introduce right-handed chirality components. In order to naturally avoid neutral flavor-changing processes, only models which have one standard Higgs doublet were studied. By elucidating the symmetry structure of the model it was, thereby demonstrated the importance of a certain Z_3 discrete symmetry in preventing the appearance of unwanted Higgs-fermion Yukawa couplings. 6 refs., 4 figs., 2 tabs.

47837 (UM-P–89/68) **The quantization of the electric charge in gauge theories.** He Xiao-Gang; Joshi, G.C.; McKellar, B.H.J. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 14p. (OZ–89/20). Order Number DE90639161. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The quantization of the electric charges of the gauge bosons, the Higgs bosons and the fermions in gauge theories was studied. The intimate relation of the quantization of the electric charge with the spontaneous symmetry breaking, anomaly cancellation and majorana mass of fermions was investigated. Specific examples for the standard model and the SU(5) X $U(1)_Z$ model are discussed. It is found that in these models the electric charges of particles are dynamically quantized. 10 refs.

47838 Heavy quarks at hadron colliders. Paige, F.E. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). pp. 62-74 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses a conference at which the standard model requiring the existence of a top quark + to form a weak isospin doublet with the b quark is explored. Collaboration suggestions are offered. Results are explored.

47839 Effects of fourth-generation quarks in the B meson system. Hamzaoui, C. (Concordia Univ., Loyola Campus, Montreal, PQ (Canada). Dept. of Physics); Sanda, A.I.; Soni, A. pp. 196-201 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper investigates the role of fourth generation quarks (t′, b′) on the B - $\bar{B}$ mixing, B meson rare decay and B meson CP violation. The authors impose a set of assumptions in the KM matrix elements. These assumptions together with the constraint that the description of K meson decays is not grossly modified lead to the conclusion that $m' > 500$ GeV, if it were to give nontrivial contribution to the B - $\bar{B}$ mixing. The analysis shows that B meson rare decays will have negligible effect from loop diagrams containing t^{prime} if out assumption are valid. The authors conclude that CP violation in B meson decays will be modified in a controlled Manner. In particular, measurement of asymmetries in both $B \rightarrow \pi$ and $B \rightarrow$, reveal the existence of new physics contribution of M_{12}.

47840 Rare decays of the Z and the standard model, fourth generation, and beyond. Weiler, T.J. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). pp. 280-290 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper addresses several issues in rare decays of the Z. The rate for flavor-changing Z decay grows as the fourth power of the fermion masses internal to the quantum loop, and so offers a window to the existence of ultraheavy (m_w) fermions. In the standard model, with three generations, $BR(Z \rightarrow bs)=10^{-7}$ and $BR(Z \rightarrow tc)=10^{-13}$. With four generations, $BR(Z \rightarrow bb_4)$ may be as large as 10^{-5} if $m_{b4} z$; and similarly for $BR(Z \rightarrow N\nu)$, where N_4 is the possible heavy fourth generation neutrino. In supersymmetric and other two Higgs doublet models, $BR(Z \rightarrow tc)$ may be as large at 5×10^{-6} in the three generations scheme. With minimal supersymmetry, the reaction $Z \rightarrow H\gamma$ is guaranteed to go, with a parameter-dependent branching ratio of $10^{-6\pm3}$.

47841 Calculability of the flavor-mixing parameters. Kang, K. (Brown Univ., Providence, RI (USA). Dept. of Physics). pp. 378-387 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper traces the origin of the flavor mixing through the fermion mass matrix and the calculability of the mixing parameters is defined whereby restricting the structure of the mass matrices. Calculability is then carried out in three and four generation problems and tested against the experimental information. The author gives the extension of the KM parametrization to arbitrary number of generations.

47842 The fourth family as a source of radiative masses for the first two. Ma, E. (California Univ., Riverside, CA (USA). Dept. of Physics). pp. 323-326 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper presents a model in which realistic radiative quark and lepton masses are obtained for the first two families in the standard SU(2) x U(1) electroweak gauge model by the addition of a fourth family, together with some extra Higgs-boson doublets and a Z_4 discrete symmetry which is softly broken down to Z_2.

47843 Rare decays and the fourth generation. Hewett, J.L. (Wisconsin Univ., Madison, WI (USA). Dept. of Physics). pp. 346-352 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses the contributions of a fourth generation of fermions to the rare decays $K \rightarrow \bar{\nu}\nu$, $b \rightarrow s\gamma$, and $b \rightarrow sl^+l-$, as well as to B^0 - $\bar{B}^0$ mixing within the context of all extensive numerical investigation of the 4 x 4 Kobayashi-Maskawa (KM) matrix. In this analysis the author required consistency between the KM matrix elements and charge current/unitarity data and the experimental values of ϵ, ϵ'/ϵ, and B^0 - $\bar{B}^0$ mixing. The resulting rates for these rare processes in the four generation standard model span a wide range of values, and can either enhance or suppress the predicted three generation rates.

47844 Quark mass ratios in semi-leptonic quark decays. Nir, Y. (Stanford Univ., CA (USA)). pp. 318-322 of Proceedings of the

fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

In this paper, an ambiguity in the calculation of CKM matrix elements from semi-leptonic decay rates is resolved:" for every choice of scales for the quark masses in the phase-space factor and in the QCD-correction factor, there corresponds a specific QCD-correction factor. This factor is modified in such a way as to make the final result independent of the scales. Specific expressions are given for the case of on-shell quark masses and for the case where both masses are taken at a single common scale. A calculation of —V_{cd}— and —V_{ub}/V_{cd}— is carried out in view of these clarifications.

47845 Mixing of the fourth family neutral hadrons. Nandi, S. (Oklahoma State Univ., Stillwater, OK (USA). Dept. of Physics); Zhang, L. pp. 362-368 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper presents, within the standard model, an exact calculation of the effective Hamiltonian generated by the box diagrams when both the external and internal quarks are arbitrarily heavy. The authors use this result to calculate the mixings of the neutral hadrons involving one fourth generation quark. Large $B' - \bar{b}'$($B' \equiv b'\bar{b}$) mixing is predicted for a wide range of b′, t and t′ masses.

47846 The electric dipole moment of the neutron. Pakvasa, S. (Dept. of Physics and Astronomy, Univ. of Hawaii at Manoa, Honolulu, HI (US)); He, X.G.; McKellar, B.H.J. pp. 491-498 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

According to this paper, there are many different theories of CP violation which can fit observations in the K - $\bar{K}$ system. The authors report on a systematic approach to calculating the neutron electric dipole moment in a variety of theories and summarize their results.

47847 Mixing of ordinary and exotic quarks. Rizzo, T.G. (Wisconsin Univ., Madison, WI (USA). Dept. of Physics). pp. 411-419 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper considers the mixing of a new Q = – 1/3 vector-like isosinglet quark, h, with the usual bottom quark (b). Using data on the Kobayashi-Maskawa mixing matrix, $\epsilon, \epsilon'/\epsilon$, B and D - $\bar{D}$ mixing the author analyzes the influence of h on a number of rare processes, e.g., $K \rightarrow \nu$, $b \rightarrow s\gamma$, and $D \rightarrow -$. Such exotic fermions can appear in E_6 superstring-inspired models.

47848 Electromagnetic penquins in B decays. Deshpande, N.G. (Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science); Trampetic, J. pp. 424-430 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

This paper discusses higher order electroweak effects that can be effectively tested in B decays involving the short-distance flavor-changing $b \rightarrow s$ transition. The authors estimate the exclusive rates involving a virtual photon like $\rightarrow K\ell\bar{\ell}$ and real photon like $\rightarrow K^*\gamma$ using relativistic constituent quark model to calculate the different form factors that include recoil effects. The effects of QCD enhancement, and the resulting e-μ rate difference, as well as the long-distance effects and the effect of the fourth generation in enhancing the rates are also discussed.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 47818, 47819, 47821, 47822, 47837, 47838, 47839, 47842, 47846, 47847

47849 (FNAL/C–90/170-T) **Dynamical symmetry breaking of the electroweak interactions and the renormalization group.** Hill, C.T. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1990. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9007168–1: 1990 workshop on dynamical symmetry breaking; 25. IUPAP international conference on high energy physics, Nagoya (Japan); Singapore (Singapore), 24-27 Jul 1990; 2-8 aug 1990; CONF-900822–8). Order Number DE90017263. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We discuss dynamical symmetry breaking with an emphasis on the renormalization group as the key tool to obtaining reliable predictions. In particular we discuss the mechanism for breaking the electroweak interactions which relies upon the formation of condensates involving the conventional quarks and leptons. Such a scheme indicates that the top quark is heavy, greater than or of order 200 GeV, and gives further predictions for the Higgs boson mass. We also briefly describe recent attempts to incorporate a 4th generation in a more natural scheme. 13 refs., 3 figs., 1 tab.

47850 (JINR-E–2-89-123) **Extensions of the Krichever-Novikov superalgebras in the Ramond and Neveu-Schwarz closed superstring theory.** Osipov, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 7p. Order Number DE90638822. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Special extensions for the Neveu-Schwarz and Ramond-type superalgebras, corresponding to a closed string propagating on the compact Riemann surface of an arbitrary genus g, are discussed. These superalgebras describe a fixed-gauge quantum system. Realization of the given algebras in terms of the dynamic string variables is obtained. 12 refs.

47851 (UM-P–89/91) **A quark-lepton symmetric model.** Foot, R. (Wisconsin Univ., Madison, WI (USA). Dept. of Physics); Lew, H. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 12p. (MAD/TH–89-15). Order Number DE90638823. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The notion that there exists a fundamental quark-lepton symmetry is proposed. To implement this symmetry, leptons (as well as quarks) are assumed to come in three colours, i.e. the gauge group of the world is assumed to be SU $(3)_q$ tensor product $SU(3)_l$ tensor product SU $(2)_L$ tensor product $U(1)_Y$ [1]. From the consistency considerations of gauge invariance and anomaly cancellation , the form of a Z_2 discrete symmetry which transforms quarks to leptons (and leptons to quarks). is derived. It is shown that such a theory can reproduce the standard model at low energies (i.e. $\sqrt{s} \leq 100$ GeV), and hence quark-lepton symmetry may be realized in nature. 11 refs.

47852 (UM-P–89/96) **Equivalence between deep energy-dependent and shallow angular momentum dependent potentials.** Fiedeldey, H. (University of South Africa (UNISA), Pretoria (South Africa). Dept. of Physics); Sofianos, S.A.; Papastylianos, A.; Amos, K.A.; Allen, L.J. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 16p. Order Number DE90638824. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Recently Baye showed that supersymmetry can be applied to determine a shallow l-dependent potential phase equivalent to a deep potential, assumed to be energy-independent and have Panli forbidden states (PFS), for α-α scattering. The PFS are eliminated by this procedure. Such deep potentials are generated as equivalent local potentials (ELP) to the Resonating Group Model (RGM) and are generally energy-dependent. To eliminate this E-dependence as required for the application of Baye's method, l-dependent, but E-independent, deep local potentials were generated by the exact inversion method of Marchenko. Subsequently, the supersymmetric method was used to eliminate the PFS, ensuring that the generalized Levinson theorem is satisfied. As an example, the method was applied to the simple model of two dineutrons scattering in the

RGM, where the deep ELP of Horiuchi has a substantial energy-dependence and one PFS only for I=O. 16 refs., 5 figs.

6454 Field Theory

Refer also to citation(s) 47818, 47821, 47838, 47839, 47840, 47841, 47842, 47843, 47844, 47847, 47848, 47902

47853 (DOE/ER/05490–111) **Convergence of Langevin simulation for complex Gaussian integrals.** Haymaker, R.W.; Peng, Yingcai. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Physics and Astronomy. 1990. 2p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-77ER05490. (CONF-9006267–2: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE90017402. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We studied the convergence of complex Langevin simulations for simple Gaussian integrals analytically, and obtained the eigenvalues and eigenfunctions of the corresponding Fokker-Planck equations. This shows the convergence explicitly. 6 refs.

47854 (DOE/ER/40231–T9) **Research program in elementary particle theory: Outstanding Junior Investigator Program: Progress report for the period ending December 31, 1990.** Bowick, M.J. Syracuse Univ., NY (USA). [1990]. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER40231. Order Number DE90017285. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics: aspects of string theory; nonlinear sigma models and high-$T_c$superconductivity; axionic black holes; topological mass generation; and quantum gravity in 2 + 1 dimensions. (LSP)

47855 (JINR-E–2-89-127) **Harmonic superspace: how it works.** Ivanov, E.A.; Ogievetskij, V.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 15p. Order Number DE90638767. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The basics of the Harmonic Superspace Approach are introduced and its applications in various areas are presented. These include N=2 matter, Yang-Mills and supergravity theories, N=3 Yang-Mills theory, self-dual N=0 Yang-Mills, hyper-Kaeler geometry,etc. 25 refs.; 1 tab.

47856 (JINR-E–2-89-321) **On particle creation by a time-dependent scalar field.** Dolgov, A.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki); Kirilova, D.P. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 14p. Order Number DE90638768. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The probability of particles creation by a homogeneous scalar field $X^{(t)}$ is calculated. Explicit analytical expressions are obtained in two limiting cases in the quasiclassical approximation and in the framework of perturbation theory. In the case when the mass of the created particles is defined by the time-dependent field $X^{(t)}$ according to the expression $g_X{}^{(t)}$ Ψ-barΨ, where $X^{(t)}=X_0$ $^{cos}(\omega t)$, it is shown that the creation probability is suppresed not exponentially, but as $\omega^{1/2}$. Some cosmological consequences of the results are discussed. 13 refs.

47857 (NBI-HE–89-27) **Dyson-Schwinger equations for the non-linear σ-model.** Drouffe, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique); Flyvbjerg, H. Niels Bohr Inst., Copenhagen (Denmark). Aug 1989. 25p. Order Number DE90638769. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Dyson-Schwinger equations for the O(N)-symmetric non-linear σ-model are derived. They are polynomials in N, hence 1/N-expanded ab initio. A finite, closed set of equations is obtained by keeping only the leading term and the first correction term in this 1/N-series. These equations are solved numerically in two dimensions on square lattices measuring 50x50, 100x100, 200x200, and 400x400. They are also solved analytically at strong coupling and at weak coupling in a finite volume. In these two limits the solution is asymptotically identical to the exact strong- and weak-coupling series through the first three terms. Between these two limits, results for the magnetic susceptibility and the mass gap are identical to the Monte Carlo results available for N=3 and N=4 within a uniform systematic error of $O(1/N^3)$, i.e. the results seem good to $O(1/N^2)$, though obtained from equations that are exact only to O(1/N). This is understood by seeing the results as summed infinite subseries of the 1/N-series for the exact susceptibility and mass gap. We conclude that the kind of 1/N-expansion presented here converges as well as one might ever hope for, even for N as small as 3. (orig.).

47858 (NBI-HE–89-28) **Scaling vs. asymptotic scaling in the non-linear σ-model in 2D: Continuum version.** Flyvbjerg, H. Niels Bohr Inst., Copenhagen (Denmark). Jul 1989. 14p. Order Number DE90638770. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The 2-point function of the O(N)-symmetric non-linear σ-model in two dimensions is large-N expanded and renormalized, neglecting terms of $O(1/N^2)$. At finite cut-off, universal, analytical expressions relate the magnetic susceptibility and the dressed mass to the bare coupling. Removing the cut-off, a similar relation gives the renormalized coupling as a function of the mass gap. In the weak coupling limit these relations reproduce the results of renormalization group improved weak coupling perturbation theory to two-loop order. The constant left unknown, when the renormalization group is integrated, is determined here. The approach to asymptotic scaling is studied for various values of N. (orig.).

47859 (NBI-HE–90-16) **Summing over all genera for d>1: A toy model.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)); Durhuus, B.; Jonsson, T. Niels Bohr Inst., Copenhagen (Denmark). Apr 1990. 18p. Order Number DE90638771. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We consider a reduced model of discretized random surfaces which is believed to be a good approximation to the standard theory of discretized random surfaces for large dimensions d. In this model we observe multicritical behaviour. The relation between internal observables, in the sense of two-dimensional gravity, and external observables, in the sense of string theory, can be studied in detail. Furthermore, it is possible to perform explicitly the summation over all genera in this model. (orig.).

47860 (NORDITA–89/29-P(prepr.)) **N-point g-loop vertex for a free fermionic theory with arbitrary spin.** Di Vecchia, P. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)); Pezzella, F.; Frau, M.; Hornfeck, K.; Lerda, A. Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark). Jul 1989. 57p. Grant DE-AC02-76ER03069. (CTP–1763;LAPP-TH–257/89). Order Number DE90638772. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

We use the sewing procedure of the operator fomalism to construct explicitly the N-Point g-Loop Vertex $V_{N;g}$ for a free fermionic (b, c)-system with conformal weight (λ, 1-λ). We show that this Vertex has the structure we expect from geometrical arguments. We obtain also several geometrical objects, e.g. the holomorphic λ differentials on an arbitrary Riemann surface, which turn out to be expressed as a Poincare θ series over all elements of the Schottky group. From $V_{N;g}$ we compute explicitly correlation functions for our system, finding agreement with the geometrical procedure. (orig.).

47861 (NORDITA–89/30-P(prepr.)) **The sewing technique and correlation functions on arbitrary Riemann surfaces.** Di Vecchia, P. Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark). 1989. 21p. Order Number DE90638773. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We describe in the case of free bosonic and fermionic theories the sewing procedure, that is a very convenient way for constructing correlation functions of these theories on an arbitrary Riemann surface from their knowledge on the sphere. The fundamental object that results from this construction is the N-point g-loop vertex. It summarizes the information of all correlation functions of the theory on an arbitrary Riemann surface. We then check explicitly the bosonization rules and derive some useful formulas. (orig.).

47862 (NORDITA–90/2-P(prepr.)) **N point g loop vertex for free fermions.** Di Vecchia, P. Nordisk Inst. for Teoretisk Atomfysik,

Copenhagen (Denmark). 1990. 25p. (CONF-8910444–: International symposium Ahrenshoop, Ahrenshoop (German Democratic Republic), 9-13 Oct 1989). Order Number DE90638774. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In this lectures we discuss in great detail the properties of free fermions with conformal dimension equal to 1/2 and we construct the N Point g loop Vertex that is the 'generating functional' of the correlation functions of the theory on arbitrary Riemann surfaces. (orig.).

47863 **Recent CLEO results on B decays.** Mistny, N.B. (Cornell Univ., Ithaca, NY (USA). Newman Lab. of Nuclear Studies). pp. 103-115 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

According to this paper, indirect evidence for a fourth generation can appear as inconsistencies in the three generation Cabbibo-Kobayashi-Maskawa description of weak decays. B decays offer a sensitive probe for such inconsistencies. Recent CLEO results are presented that are relevant to questions bearing on the possible existence of further generations. Future prospects with CLEO-II and CESR are mentioned.

47864 **The τ-lepton lifetime discrepancy as evidence for the fourth family.** Rajpoot, S. (California Univ., Riverside, CA (USA). Dept. of Physics). pp. 405-410 of Proceedings of the fourth family of quarks and leptons. Second international symposium. Cline, D.B.; Soni, A. The New York Academy of Sciences, New York, NY (USA) (1989). (CONF-8902110–: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (USA), 23-25 Feb 1989).

According to this paper, the measured lifetime of the tau lepton suggests that the e - μuniversality may not hold in the case of the third generation leptons. The universality of weak interactions can be restored by involving the existence of a fourth family of leptons and quarks. The charged lepton of the fourth family mixes with the tau lepton with a Cabibbo-like mixing angle. Agreement between the experimentally measured lifetime and the theoretical value as predicted by the standard $SU(2)_l \times U(1)$ model on the basis of universality of weak interactions required the Cabibbo-like mixing angle (ϕ) to satisfy $\cos\phi = 0.96 \pm 0.02$. For this mixing to be non-trivial, the neutrino associated with the fourth family charged lepton must be more massive than the tau lepton. The mass of the fourth family charged lepton is predicted to be less than 45 GeV if the relation between the masses and the mixing angle is given by Weinberg type formula i.e. $\tan\phi$ = Square root of m_τ/m_χ where χ denotes the charged lepton of the fourth family.

65 PHYSICS II

6510 Nuclear Physics

Refer also to citation(s) 47434, 47805, 47901

47865 (ANL–90/18) **Physics Division annual review, April 1, 1989–March 31, 1990.** Argonne National Lab., IL (USA). Jul 1990. 359p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE90018010. Source: NTIS, PC A16/MF A01; OSTI; INIS; GPO Dep.

This report contains papers in the following research areas: research at atlas; operation and development of atlas; medium-energy nuclear physics and weak interactions; theoretical nuclear physics; and atomic and molecular physics research.

47866 (BNL–44992) **Physics at Relativistic Heavy Ion Collider (RHIC).** Shuryak, E.V. Brookhaven National Lab., Upton, NY (USA). Aug 1990. 36p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900772–3: 4. workshop on experiments and detectors for a relativistic heavy ion collider, Upton, NY (USA), 2-7 Jul 1990). Order Number DE90017201. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This introductory talk contains a brief discussion of future experiments at RHIC related to physics of superdense matter. In particular, we consider the relation between space-time picture of the collision and spectra of the observed secondaries. We discuss where one should look for QGP signals and for possible manifestation of the phase transition. We pay more attention to a rather new topic: hadron modification in the gas phase, which is interesting by itself as a collective phenomenon, and also as a precursor indicating what happens with hadrons near the phase transition. We briefly review current understanding of the photon physics, dilepton production, charm and strangeness and J/ψ suppression. At the end we try to classify all possible experiments. 47 refs., 3 figs.

47867 (DOE/ER/40256–5) **[Cyclotron based nuclear science]: Progress report, April 1, 1989–July 31, 1990.** Texas A and M Univ., College Station, TX (USA). Cyclotron Inst. Aug 1990. 164p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER40256. Order Number DE90016502. Source: NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

This report contains descriptions of research programs carried out by institute staff, in nuclear physics as well as progress on new instrumentation during the period April 1, 1989, to July 31, 1990. During this year the ECR source was completed and beams were injected into the cyclotron. In November, 1989 experiments began with beams from the ECR + K500 cyclotron. To date, the highest velocity beam accelerated has been 43 MeV/nucleon ^{14}N, and the highest energy beam has been 1.57 GeV ^{63}Cu. Heavy ion reaction experiments and cyclotron operation and instrumentation are briefly described in this paper.

47868 (DOE/ER/40404–2) **Nuclear chemistry progress report, [August 1, 1989–July 31, 1990].** Indiana Univ., Bloomington, IN (USA). Aug 1990. 64p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER40404. Order Number DE90016307. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This report briefly discusses research being done in the following areas: intermediate-energy reactions; damped collisions; and detector development and chemical education. (LSP)

47869 (FNAL/C–89/261-E) **Jet dynamics at the Tevatron collider.** Plunkett, R. The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). Dec 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8909291–11: 8. topical workshop on proton-antiproton collider physics, Castiglione della Pescaia (Italy), 1-5 Sep 1989). Order Number DE90016903. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Results for processes involving two or more hadronic jets at $\sqrt{s}$ = 1800 GeV are presented. The data are compared with the results predicted from perturbative QCD. 16 refs., 10 figs.

47870 (INDC(CPR)–16) **Compilation of measurements and evaluations of nuclear activation cross sections for nuclear data applications.** Zhao Wenrong (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Lu Hanlin; Yu Weixiang; Yuan Xialin. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Aug 1989. 93p. Order Number DE90637876. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The cross-sections of fifty-eight reactions of interest for nuclear technology applications have been measured by the activation method in our laboratory. For the same reactions, compilations and evaluations of available neutron activation cross-sections have been made. Table 1 lists all of the reactions included in the present work. A brief description of experimental measurements for activation cross-sections is given. The evaluation procedure is described. The collected data were modified as needed to account for recent revisions in nuclear constants and standard cross-sections. For each reaction, the data measured by ourselves and our evaluations are listed in Tables 3 and 4 respectively. A graphical intercomparison with available experimental data is given. References can be found for each investigated reaction. (author). Refs, figs and tabs.

47871 (LA-UR–90-2717) **Measurement of kaons in the Helios experiment.** van Hecke, H. Helios Collaboration. Los Alamos

National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900570–9: 8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90, Menton (France), 7-11 May 1990). Order Number DE90016513. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We have measured kaons and pions in the rapidity interval 0.8–1.3 and p_T interval 100–600 MeV/c. We have observed an excess in the ratio of positive kaons to pions over what is expected from p-p for transverse momenta above 300 MeV/c. No such excess is seen for negatives. This excess of K/π increasing with p_T has been observed in 14.5 GeV/A Si + Au collisions by E802 at the AGS. Though their data are concentrated at high p_T, there is a small region of overlap between the coverage of HELIOS and E802 for p_T = 0.4–0.5 GeV/c. In this region the K/π ratios for both positive and negative particles are very similar even though the bombarding energies differ by more than an order of magnitude. We find no strong indication that the rise in K/π above values expected from p-p collisions is higher for high-E_T events than for low-E_T events.

47872 (ORNL/FTR–3735) **[Improvements in ENDF/B-VI evaluation for iron and its possible impacts on pressure vessel surveillance dosimetry]: Foreign trip report, August 24, 1990–September 1, 1990.** Fu, C.Y. Oak Ridge National Lab., TN (USA). 10 Sep 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90017560. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler was invited to the symposium to present a paper on the improvements in ENDF/B-VI evaluation for iron and its possible impacts on pressure vessel surveillance dosimetry. A second paper on the ENDF/B-VI evaluations for Si, Cr, Fe, and Ni for improved radiation damage analysis was also presented by the traveler. Meeting highlights in the areas of nuclear data and radiation damage analysis are presented in this report.

47873 Kinetic energy and charge distributions of multiply charged ions produced by heavy ions and by synchrotron radiation. Levin, J.C. (Univ. of Tennessee, Knoxville (USA)); Biedermann, C.; Cederquist, H.; Liljeby, L.; Short, R.T.; Sellin, I.A. pp. 18, Paper NUCL 62 of American Chemical Society, Division of Nuclear Chemistry and Technology, national meeting. American Chemical Society, Washington, DC (US) (1989). (CONF-8904160–: Symposium on chemical applications of particle accelerators, Dallas, TX (USA), 9-14 Apr 1989).

This paper contrasts two methods of production of multiply charged ions which may have application in future hot-atom chemistry experiments. Interest in extending the study of ion-atom collisions from MeV to keV to eV energies has grown rapidly in the last decade as previously inaccessible astrophysical, fusion, and spectroscopic problems have been addressed. One of these methods involves highly charged secondary beams formed from ions created in dilute gas samples irradiated by fast (MeV), high-charge-state, heavy ions. The measurements show, however, that such ions often have mean recoil energies two orders of magnitude higher than kinetic energies of ions in similar charge states resulting from vacancy cascades of atomic inner shells photoionized by synchrotron x rays. These results may be applicable to development of a cold source of highly charged ions featuring low energy spread and good angular definition. Results from other laboratories (Grandin et al at Ganil, Ullrich et al in Frankfurt, and Watson et al at Texas A & M) will also be discussed.

47874 A new separation procedure for Cu-67. Mausner, L.F. (Brookhaven National Laboratory, Upton, NY (USA)); Das Gupta, A.K.; Srivastava, S.C. pp. 29, Paper NUCL 99 of American Chemical Society, Division of Nuclear Chemistry and Technology, national meeting. American Chemical Society, Washington, DC (US) (1989). (CONF-8904152–: American Chemical Society Division of Nuclear Chemistry and Technology, Dallas, TX (USA), 9-14 Apr 1989).

Copper-67 ($t_{\frac{1}{2}}$ = 62 h, E_β(max)= 577, 484, 395 keV) is an attractive radionuclide for immunotherapy. It has been produced since 1985 at the Brookhaven Linac Isotope Producer with 200 MeV protons on Zn targets (Int.J.Appl.Radiat.Isot.37,29,1986). The method for isolation of Cu using electrodeposition and ion exchange is, however, slow (24 h) and unreliable for remote operation. A new, faster method has been devised. The dissolved Zn target in 0.5 N HCl is treated with 0.01% dithizone in CCl_4. An average of 96% Cu extracts into the organic phase with negligible Zn (1%) and Ga (2%) contamination. After washing the dithizone layer with 0.02 N HCl, the Cu is back extracted into 7.2 N HCl (with a few drops of H_2O_2). Residual ^{67}Ga is removed by extraction into isopropyl ether saturated with 7.2 N HCl. The aqueous phase is warmed to remove ether and is then passed through a Dowex-1 anion exchange column equilibrated with 6 N HCl. The Cu activity is eluted with 1 N HCl. The overall Cu-67 recovery is 90% under remote conditions. The Ga-67 separation is complete, the Zn separation factor is about 1×10^{-5} and the chemical procedure requires less than 3 hours.

47875 Production and purification of radionuclides for therapeutic applications. Atcher, R.W. (Argonne National Laboratory, IL (USA)). pp. 16, Paper NUCL 57 of American Chemical Society, Division of Nuclear Chemistry and Technology, national meeting. American Chemical Society, Washington, DC (US) (1989). (CONF-8904161–: Symposium on the therapeutic applications of radionuclides, Dallas, TX (USA), 9-14 Apr 1989).

The use of non-encapsulated radionuclides for therapy in vivo has developed beyond the simple use of I-131 for therapy in thyroid disease. The use of biomolecules that have affinity for the target tissues has expanded the potential of this approach for therapy. The production of these radionuclides must meet more stringent requirement of radionuclidic and radiochemical purity in order to be used effectively while minimizing non-target dose. Particle emission (either alpha particles, beta particles or Auger electrons) is the basis for therapy. The source of a majority of these radionuclides is usually a nuclear reactor, especially for beta emitters. Auger electron emitters are often produced by charged particle accelerators. Finally, the alpha emitters can be produced from both of these facilities as well as from naturally occurring radionuclides. The methods of purification vary with the method of production and include ion exchange chromatography, solvent extraction and distillation. Both the production and purification present continuing challenges for the radiochemist.

6511 Experimental Techniques

Refer also to citation(s) 47873

6512 Nuclear Properties and Reactions, A = 1-5, Experimental

Refer also to citation(s) 47982

47876 (LA-UR–90-2737) **Multi-nucleon phenomena in pion-nucleus reactions.** Gram, P.A.M. Los Alamos National Lab., NM (USA). [1990]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900601–6: 12. international conference on particles and nuclei, Cambridge, MA (USA), 24-29 Jun 1990). Order Number DE90016510. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

At the peak of the delta resonance, the pion is the most strongly interacting particle we know. It follows that interactions between pions and nuclei at these energies all tend to involve multiple scattering to some degree. Multiple scattering includes different kinds of processes. In its simplest forms, it involves a sequence of interactions with single nucleons that take place as the pion bumbles its way through a nucleus. Much more interesting is the possibility that there are interactions that in some sense directly involve several nucleons at once. If there are such interactions, can we distinguish between them and the simpler, more prosaic forms of multiple scattering? Experimental study of pion-nucleus reaction mechanisms has produced intriguing suggestions that truly multi-nucleon interactions do occur. They are the subject of this paper. To develop this subject I will focus on reactions that cannot happen at all without the essential participation of two or more nucleons.

6513 Nuclear Properties and Reactions, A = 6-19, Experimental

47877 (JINR-R-1-89-46) **Dependence of characteristics of hadron-carbon interactions at 4-40 GeV/c with cumulative π-meson and proton emission on target mass and their connection with formation of particles with large transverse momenta.** Lyubimov, V.B.; (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Togoo, R.; Baatar, Ts.; Tuvdendorzh, D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1989. 8p. (In Russian). Order Number DE90639221. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Two types of pC- and π^-C-interactions (P_p=4.2 and 10 GeV/c, P_{π^-}=40 GeV/c) accompanied by emission of either cumulative π-mesons or cumulative protons have been analysed using the pictures from the 2m-propane bubble chamber. The analysis was made depending on the target mass wich an incident hadron is colliding and on the number of charged secondary particles with large transverse momenta. According to the most of characteristics (cross sections, multiplicities, etc.) two types of investigated interactions differ from each other, and collisions with cumulative π-meson emission have some universal characteristics not depending on the primary energy. 13 refs.; 6 figs.

47878 (JINR-R-3-89-334) **The measurements of gamma-spectra emitted in capture of thermal neutrons by ^{11}B nuclei.** Taran, Yu.V.; Sharapov, Eh.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1989. 4p. (In Russian). Order Number DE90639222. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The spectra of gamma rays emitted on radiative capture of thermal neutrons in Be, ^{11}B and C are measured. The Be and C spectra have shown all the known transitions with energies above 1 MeV. These elements were used as a standard to determine absolute gamma-yield following the decay of the ^{12}B compound state, where are observed only a direct transition to the ground state with a yield of 20±8 gamma quanta per 100 capture events. 9 refs.; 3 figs.; 1 tab.

47879 (JINR-R-3-89-408) **Scattering of keV neutrons by Be,B,C nuclei.** Lyapin, D.I.; Mitsyna, L.V.; Popov, A.B.; Salamatin, I.M.; Samosvat, G.S. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1989. 6p. (In Russian). Order Number DE90639223. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Results of the measurement of the neutron elastic scattering cross sections are given for elementary Be,B and C at energies up to ≈ 300 KeV. Parameters R_l^∞ of the potential scattering for the the s- and p-wave neutrons are obtained from these cross sections. Significant discrepancy of the parameters R_l^∞ are explained by the influence of the negative p-wave resonances of ^{9}Be and ^{11}B for which the reduced neutron widths estimations are obtained. 9 refs.; 1 fig.; 3 tabs.

6515 Nuclear Properties and Reactions, A = 39-58, Experimental

Refer also to citation(s) 47876

47880 (CONF-900814-10) **Improvements in ENDF/B-VI iron and possible impacts on pressure vessel surveillance dosimetry.** Fu, C.Y.; Hetrick, D.M.; Perey, C.M.; Perey, F.G.; Larson, N.M.; Larson, D.C. Oak Ridge National Lab., TN (USA). [1990]. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90016528. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The ENDF/B-VI cross-section evaluations for the four iron isotopes are summarized, emphasizing the major improvements over ENDF/B-V. The evaluations were mostly based on a preliminary file generated in 1986 for natural iron that has been used for recalculating several neutron-transport experiments, of all which showed improved agreement. These re-analyses, including those for pressure-vessel surveillance dosimetry, are also discussed. 20 refs., 3 figs.

47881 (SINS-2079/P-1/PL/B) **One-particle and collective phenomena in the (n,p) reactions at neutron energy close to 20 MeV.** Rondio, J. Institute for Nuclear Studies, Otwock-Swierk (Poland). May 1989. 123p. (In Polish). Order Number DE90639227. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The differential cross-sections of the ^{58,60}Ni(n,p) reactions were measured at the 17.3 MeV and 18.5 MeV neutron energies. The interplay of the precompound processes and of the GDR excitation as a doorway state and as a parent analog was investigated. The reaction mechanism was discussed in terms of the statistical multistep emission theory of Feshbach, Kerman and Koonin and of the Geramb model of inelastic nucleon scattering. The transitions to parent analog states of M1 GDR were also identified. The experimental values of total proton emission cross sections were determined for investigated reactions and were compared with the values calculated on the basis of SMCE theory of F.K.K. 104 refs., 52 figs., 12 tabs. (author).

6516 Nuclear Properties and Reactions, A = 59-89, Experimental

Refer also to citation(s) 47881

47882 (AD-A-222561/3/XAB) **Study of short-lived unstable nuclei by means of laser optical pumping. (Final report). Doctoral thesis.** Mackin, J.P. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Physics. Jun 1990. 158p. Source: NTIS, PC A08/MF A01.

The effectiveness of laser-induced nuclear orientation in the study of short-lived unstable nuclei using radiation detection has been increased by the use of saturation spectroscopy to produce sub-Doppler resolved changes in the anisotropic spatial distribution of the 514-keV gamma rays from the 1 - mu-s isomer Rb(85m). The width (HWHM) of these change signals is about 60 MHz, a factor of ten better than Doppler-broadened signals previously obtained. This technique has been used to study the D1 and D2 transitions for the isomer. Precise values of the hyperfine A and B coefficients have been determined, and used to extract a value for the nuclear magnetic dipole moment (6.043 + or - .005) mu sub N, and, for the first time, a measured value of the nuclear quadrupole moment (-.73 + or - .17)b. Additionally, and a new, more accurate value for the isomer shift (-113 + or - 5)MHz has been determined.

47883 (BNL-44968) **Silicon ion interactions measured in the E-810 TPC [Time Projection Chamber] at the AGS.** Love, W.A. The E-810 Collaboration. Brookhaven National Lab., Upton, NY (USA). [1990]. 5p. Sponsored by City University of New York; U.S. DOE Energy Research. DOE Contract AC02-76CH00016 ;AC02-83ER40107 ;AS05-81ER40032 ;AC (CONF-900570-10: 8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90, Menton (France), 7-11 May 1990). Order Number DE90017199. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The tracking detector of AGS Experiment 810 is a three-piece Time Projection Chamber (TPC) which measures all charged tracks in the forward hemisphere of the nucleon-nucleon center of mass system, i.e. forward of 20 degrees in the lab. Each module of the TPC contains twelve rows of short anode wires which give 3-D space points on each track, but no dE/dx information usable for particle identification. The MPS magnet provides a uniform 5 kG field on the TPC volume. The TPC was operated in a beam of 14.6 × A GeV/c silicon ions at the end of June 1989. This talk reports the results of analysis of the gold and copper target data from that run. The trigger was quite simple, requiring a large pulse height in a Čerenkov counter in the incident beam indicating an incident silicon ion, a small pulse height in a scintillation counter centered on the beam behind the TPC corresponding to less ionization than a surviving carbon ion would produce, and a substantial signal in each of two scintillators located above and below the beam just in front of the TPC. The targets were thin, 0.0076 radiation lengths of gold, 0.0089 radiation lengths of copper, to reduce contamination of the events by electron tracks from converted π^0 photons. A cut

at multiplicity 50 was used to select more central collisions, yielding 2291 events from the gold sample, 2170 from the copper. This corresponds to cross sections of 0.59 and 0.20 barns, respectively, defining the "central" sample for the charged particle distributions presented here.

47884 (INP-1456/PH) **One- and two-dimensional analysis of the factorial moments in 200 GeV/nucleon p, ^{16}O and ^{32}S interactions with Ag/Br nuclei.** Holynski, R. (Institute of Nuclear Physics, Cracow (Poland)); Jurak, A.; Olszewski, A. Institute of Nuclear Physics, Cracow (Poland). Jun 1989. 19p. Order Number DE90639230. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Scaled factorial moments, corrected for the shape of the single particle pseudorapidity distribution are analysed in terms of the pseudorapidity variable and in two-dimensional (pseudorapidity and azimuthal angle) space. An intermittent, power-law growth of the moments with decreasing bin size is found in both cases, with two-dimensional analysis revealing a much stronger effect for nucleus-nucleus data. Furthermore, the intermittent patterns are more evident for proton-nucleus collisions than for the nucleus-nucleus data where the heaviest nucleus examined, ^{32}S shows the weakest effect. 15 refs., 5 figs., 3 tabs. (author).

47885 (PNL-SA-18052) **Experimental $\beta\beta$-decay: A review of recent progress.** Avignone III, F.T. (South Carolina Univ., Columbia, SC (USA). Dept. of Physics and Astronomy); Brodzinski, R.L.; Miley, H.S.; Reeves, J.H. Pacific Northwest Lab., Richland, WA (USA). May 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8905187-10: WEIN '89: international symposium on weak and electromagnetic interactions in nuclei, Montreal (Canada), 15-19 May 1989). Order Number DE90016329. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A brief discussion of recent theoretical developments in the relevant elementary particle and nuclear physics of $\beta\beta$-decay is given. Experimental results representing progress since Neutrino-88 are emphasized. Future plans and projected sensitivities of various experiments are also reported. Several positive results for 2ν $\beta\beta$-decay are critiqued. The measurement of the decay of ^{82}Se by the Irvine group is still the most compelling evidence for the direct observation of 2ν $\beta\beta$-decay in the laboratory; however, two other groups have reported evidence of this process in ^{100}Mo and ^{76}Ge. 33 refs., 8 figs.

6517 Nuclear Properties and Reactions, A = 90-149, Experimental

Refer also to citation(s) 47884, 47885

47886 (SINS-2076/P-1/PL/A) **Alpha particle emission from neutron bombardment of ^{144}Sm.** Augustyniak, W. (Institute for Nuclear Studies, Otwock-Swierk (Poland)); Glowacka, L.; Jaskola, M.; Turkiewicz, J.; Zemlo, L.; Dalmas, J.; Chiadli, A. Institute for Nuclear Studies, Otwock-Swierk (Poland). Apr 1989. 21p. Order Number DE90639231. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The energy and angular distributions of the α-particles from the ^{144}Sm (n, α)^{141}Nd reaction for 14.3 and 18.15 MeV incident neutrons were measured by means of semiconductor silicon detectors. The results are analysed in the framework of the statistical and pre-equilibrium models of nuclear reactions. Comparison of such calculations with the measured α - emission cross sections indicates that these models have failed to describe the investigated reaction. The structures observed in the shape of the spectra may be explained by shell structure of the target nucleus. 27 refs., 6 figs., 3 tabs. (author).

6518 Nuclear Properties and Reactions, A = 150-189, Experimental

47887 (OUP-90-09) **On the $^{171}Yb(^3He,\alpha)$ reaction mechanism.** Tveter, T.S. (Oslo Univ. (Norway). Fysisk Inst.); Guttormsen, M.; Rekstad, J.; Kownacki, J.; Thorsteinsen, T.F. Oslo Univ. (Norway). Fysisk Inst. Apr 1990. 12p. Order Number DE90639233. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The $^{171}Yb(^3He,\alpha xn)^{170-x}Yb$ (x=0-4) reaction at a beam energy of 45 MeV has been studied by means of $\alpha\gamma$-coincidence measurements for α-particle energies from 20 MeV to 60 MeV. A strong anisotropy in the angular distribution of the α-particles is observed for the complete energy range. At the highest α-energies the reaction is described as a one-step direct pick-up reaction. For the remaining energies an interpretation in terms of a preequilibrium reaction is suggested. High "quasi"-temperatures are observed, indicating local heating. The reaction is found to be well-localized near the surface of the nucleus. 24 refs., 7 figs., 2 tabs.

6519 Nuclear Properties and Reactions, A = 190-219, Experimental

Refer also to citation(s) 47802, 47883

47888 (BNL-45003) **The e^+, e^- background at Relativistic Heavy Ion Collider (RHIC) generated by beam crossing.** Rhoades-Brown, M.J. (Brookhaven National Lab., Upton, NY (USA)); Ludlam, T.; Wu, J.; Bottcher, C.; Strayer, M. Brookhaven National Lab., Upton, NY (USA). 10 Aug 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900772-2: 4. workshop on experiments and detectors for a relativistic heavy ion collider, Upton, NY (USA), 2-7 Jul 1990). Order Number DE90017203. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

At the Brookhaven Relativistic Heavy Ion Collider (RHIC), fully stripped heavy ions will circulate in each of two rings up to beam energies of 250 (Z/A) GeV/u. During the beam crossing, the peripheral electromagnetic interaction between the heavy ions is sufficient to induce copious production of di-lepton pairs. These pairs are a potential source of background for the detectors at RHIC. In this paper we discuss the expected number of e^+,e^- pairs, given the accepted initial luminosity value L of the collider. More importantly, we also calculate the differential cross sections for the angle, energy, rapidity and momentum distribution of the leptons. Using the luminosity L of the collider, these differential cross sections are normalized to the expected number of leptons per second. We restrict ourselves to e^+,e^- production, a discussion of μ^+,μ^- and $\tau^+\tau^-$ distributions will be published later. The results are presented for the expected worst case, namely $^{197}Au^{79+}$ ions at a beam kinetic energy of 100 GeV/u. This is forseen to be the heaviest ion for high luminosity experiments at RHIC. We note for a given energy, the cross section for e^+,e^- production scales as Z^4, where Z is the atomic number of the ions.

47889 (GSI-90-06(prepr.)) **Triaxiality and γ-softness in ^{196}Pt.** Mauthofer, A. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik); Stelzer, K.; Idzko, J.; Elze, T.W.; Wollersheim, H.J.; Emling, H.; Fuchs, P.; Grosse, E.; Schwalm, D. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Feb 1990. 67p. Source: Also published in Z. Phys., A: At. Nuclei (Jul 1990) v. 336(3) p. 263-278.

The nuclear level structure and electromagnetic properties of ^{196}Pt were investigated with γ-spectroscopic techniques using multiple Coulomb excitation by ^{208}Pb projectiles. Particle-γ, and particle-γ-γ coincidences were measured over a wide range of scattering angles. E2-transition moments and static quadrupole moments have been determined by a comparison of experimental scattering-angle dependent γ yields with calculated yields in a largely model-independent procedure. The results are compared with different theoretical models: the Asymmetric-Rotor Model, the Generalized Collective Model, and the Interacting Boson Model. The best agreement is obtained with the Generalized Collective Model representing a triaxial nucleus which is soft in the γ degree of freedom. (orig.).

6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

47890 (JAERI-M-90-025, pp. 403-413) **One group actinide cross section set based on JENDL-3 and calculation of ^{232}U production in light water reactors.** Masukawa, Fumihiro (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Nakagawa, Tsuneo; Iijima, Shungo. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1990. (CONF-8911182--: 1989 seminar on nuclear data, Tokai (Japan), 16-17 Nov 1989; NEANDC(J)-149/U; INDC(JPN)-136/L). In *Proceedings of the 1989 seminar on nuclear data.* Order Number DE90008196. Source: NTIS (US Sales Only), PC A18/MF A01.

An extensive one-group cross section set was generated based on JENDL-3 with typical ORIGEN2 spectra of LWRs and FBR, and was compared with ORIGEN2/82 and ENDF/B-V data. Using this cross section set, ^{232}U inventory in LWR was calculated under a clean burnup condition. The effect of lead time before reactor operation is shown as important for a quantitative calculation of ^{232}U inventory. Sensitivity study was made to identify the dominant nuclide transmutation paths and the effect of cross section differences relative to ORIGEN2/82 library. (author).

6530 Nuclear Theory

Refer also to citation(s) 47755, 47825, 47851, 47852, 47865

47891 (BONN-TK-88-08) **Pion production in the nucleus-nucleus collision.** Harzheim, L. Bonn Univ. (Germany, F.R.). Inst. fuer Theoretische Kernphysik; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1988. 280p. (In German). Order Number DE90519741. Source: NTIS (US Sales Only), PC A13/MF A01.

In this thesis the pionic fusion of heavy ions and the inclusive production of pions in heavy ion reactions are treated in the framework of a multi-baryon concept, in which also internal degrees of freedom of the baryons can be excited, whereby the interaction between the baryons is mediated by the exchange of mesons. (HSI).

47892 (DOE/ER/40380-2, pp. 282-311) **Structure of excited nuclei and baryons (breaking of reflection symmetry).** Gai, M. (Yale Univ., New Haven, CT (USA)). Hampton Univ., VA (USA). Dept. of Physics. [1989]. (CONF-8905332--: 4. Hampton University graduate studies (HUGS) at the continuous electron beam accelerator facility (CEBAF), Hampton, VA (USA), 30 May - 17 jun 1989). In *HUGS at CEBAF: Proceedings of the Hampton University Graduate Studies at the Continuous Electron Beam Accelerator Facility.* Order Number DE90013957. Source: NTIS, PC A15/MF A01.

The author reviews some models of Nuclear Structure as applied to nuclei and excited hadrons, with emphasis on general common aspects of observed spectra in nuclei and baryons, stemming from reflection asymmetry in the intrinsic state. The single-particle shell model is discussed and collective models are then introduced to describe collective motion in nuclei. Both the geometric collective model of nuclei and the group theoretical (IBA) approach are discussed. The shell model and the collective model are applied to ^{16}O and then to the structure by baryons. The occurrence of parity doublets in excited baryons is discussed as a natural consequence of the collective model, as observed in N^* and Δ^* spectra, for states with small total angular momentum. 28 refs., 8 figs.

47893 (GSI-90-28(prepr.)) **Nuclear lifetimes for cluster radioactivities.** Poenaru, D.N. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Schnabel, D.; Mazilu, D.; Cata, I.; Greiner, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jun 1990. 202p. Order Number DE90519759. Source: NTIS (US Sales Only), PC A10/MF A01.

Calculated half-lives, branching ratios relative to alpha decay and kinetic energies of the most probable decays by spontaneous emission of clusters are listed for nuclides with Z=52-122. Superheavies and nuclei far off the beta stability are included. Total lifetime, α decay kinetic energy and partial half-life are given for each nucleus selected to meet two criteria: partial lifetime for cluster emission $<10^{30}$ seconds and the branching ratio $>10^{-18}$. More nuclei are presented in a T_EX file, accepting half-lives $<10^{50}$ seconds and branching ratios $>10^{-30}$, if the mass of the parent nucleus has been measured or estimated from systematics by Wapstra et al. The lifetimes for cluster emissions and α decay are calculated by using the analytical superasymmetric fission model with even-odd effects taken into account and by a semiempirical formula, respectively. Q-values are determined by means of the mass tables published in 1988 in Atomic Data and Nuclear Data Tables. (orig.).

47894 (GSI-90-30(prepr.)) **Relaxation processes in intermediate-energy heavy-ion collisions.** Cubero, M. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Schoenhofen, M.; Friman, B.L.; Noerenberg, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jun 1990. 13p. (CONF-9004220--: International workshop on nuclear dynamics, Elba (Italy), 2-7 Apr 1990). Source: Available from Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.).

Covariant kinetic equations are derived from quantum hadrodynamics (QHD) and applied to heavy-ion collisions at intermediate energies ($E_{beam}<$ or approx.2 GeV/u). It is shown that medium effects strongly modify the initial equilibration process and the reabsorption of pions and deltas during the final expansion phase. (orig.).

47895 (GSI-90-31(prepr.)) **Angular correlation of electrons and positrons in internal pair conversion.** Hofmann, C. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Reinhardt, J.; Greiner, W.; Schlueter, P.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jun 1990. 36p. Order Number DE90519763. Source: NTIS (US Sales Only), PC A03/MF A01.

The angular distribution of electrons and positrons which are emitted in internal pair conversion (IPC) is calculated. Coulomb-distorted waves are used as electron wave functions. Nuclear transitions of various multipolarities $L>0$ and of magnetic (ML) and electric (EL) type are considered as well as E0-conversion. Analytical expressions for the angular correlation are derived which are evaluated numerically assuming a finite extension of the nucleus and, for the EL and ML conversion, also in point-nucleus approximation. The calculated angular correlations are compared with results obtained within the Born approximation and, for the E0 case, with experimental data. (orig.).

47896 (INDC(GDR)-057) **Contributions to the theory of fission neutron emission.** Seeliger, D. (Technische Univ., Dresden (German Democratic Republic)); Maerten, H.; Ruben, A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1990. 38p. Order Number DE90637862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This report gives a compilation of recent work performed at Technical University, Dresden by D. Seeliger, H. Maerten and A. Ruben on the topic of fission neutron emission. In the first paper calculated fission neutron spectra are presented using the temperature distribution model FINESSE for fissioning actinide nuclei. In the second paper, starting from a general energy balance, Terrell's approach is generalized to describe average fragment energies as a function of incident energy; trends of fragment energy data in the Th-Pu region are well reproduced. In the third contribution, prompt fission neutron spectra and fragment characteristics for spontaneous fission of even Pu-isotopes are presented and discussed in comparison with experimental data using a phenomenological scission point model including temperature dependent shell effects. In the fourth paper, neutron multiplicities and energy spectra as well as average fragment energies for incident energies from threshold to 20 MeV (including multiple-chance fission) for U-238 are compared with traditional data representations. (author). Refs, figs and tabs.

47897 (INDC(GDR)-057, pp. 34-38) **Theoretical model application to the evaluation of fission neutron data up to 20 MeV incidence energy.** Ruben, A. (Technische Univ., Dresden (German Democratic Republic)); Maerten, H.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1990. In *Contributions to the theory of fission neutron emission.* Order Number DE90637862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A complex statistical theory of fission neutron emission combined with a phenomenological fission model has been used to calculate fission neutron data for ^{238}U. Obtained neutron multiplicities and energy spectra as well as average fragment energies for incidence energies from threshold to 20 MeV (including multiple-chance fission) are compared with traditional data representations. (author). 19 refs, 6 figs.

47898 (INDC(GDR)–057, pp. 16-26) **Energy partition in nuclear fission.** Ruben, A. (Technische Univ., Dresden (German Democratic Republic)); Maerten, H.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1990. In *Contributions to the theory of fission neutron emission.* Order Number DE90637862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A scission point model (two spheroid model TSM) including semi-empirical temperature-dependent shell correction energies for deformed fragments at scission is presented. It has been used to describe the mass-asymmetry-dependent partition of the total energy release on both fragments from spontaneous and induced fission. Characteristic trends of experimental fragment energy and neutron multiplicity data as function of incidence energy in the Th-Cf region of fissioning nuclei are well reproduced. Based on model applications, information on the energy dissipated during the descent from second saddle of fission barrier to scission point have been deduced. (author). 39 refs, 13 figs.

47899 (INDC(GDR)–057, pp. 5-15) **Fission neutron statistical emission.** Ruben, A. (Technische Univ., Dresden (German Democratic Republic)); Maerten, H.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1990. In *Contributions to the theory of fission neutron emission.* Order Number DE90637862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The statistical model approach FINESSE (FIssion NEutronS' Statistical Emission) for the description of fission neutron multiplicities, energy spectra and angular distributions is described. Based on an extended Weisskopf ansatz and on a realistic temperature distribution it provides a fragment mass number dependent description of fission neutron data. Model parameters (optical potential, n/γ competition) were fixed on the basis of the $^{252}Cf(sf)$ (nuclear data standard). Combined with a phenomenological fission model for predicting relevant fragment data as function of asymmetry, FINESSE can be applied to any fission reaction of actinides in the Th-Cf region without further parameter adjustment. Results are presented for $^{252}Cf(sf)$ and neutron induced fission of ^{235}U, ^{239}Pu, ^{232}Th. Effects of multiple-chance fission are discussed for $^{232}Th(n,xnf)$ reacation. (author). 46 refs, 11 figs.

47900 (INDC(GDR)–057, pp. 27-33) **Prompt fission neutron spectra and fragment characteristics for spontaneous fission of even Pu-isotopes.** Maerten, H. (Technische Univ., Dresden (German Democratic Republic)); Ruben, A.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1990. In *Contributions to the theory of fission neutron emission.* Order Number DE90637862. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A phenomenological scission point model including temperature-dependent shell effects has been used to solve the energy partition problem as function of mass asymmetry for Pu-fission. Relevant fragment data were used as the basis for applying a temperature-distribution model, which yields neutron multiplicity, energy and angular distribution of prompt fission neutrons. Calculated data for ^{236}Pu, ^{240}Pu and ^{242}Pu are presented and discussed in comparison with experimental data. (author). 22 refs, 8 figs, 1 tab.

47901 (INDC(NDS)–233) **Measurement, calculation and evaluation of photon production cross-sections: Summary report.** Kocherov, N.P. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Mar 1990. 16p. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). Order Number DE90637763. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The IAEA Specialists' Meeting on Measurement, Calculation and Evaluation of Photon Production Cross-Sections was held in Smolenice, Czechoslovakia, 5-7 February 1990. The meeting was hosted by the Institute of Physics of the Electro-Physical Research Centre, Slovak Academy of Sciences, Bratislava. This report contains the conclusions and recommendations of this meeting. The papers which the participants have presented at the meeting will be published as an INDC Report. (author).

47902 (INP–1441/PH) **Quark matter in a chiral chromodielectric model.** Broniowski, W. (Institute of Nuclear Physics, Cracow (Poland)); Kutschera, M.; Cibej, M.; Rosina, M. Institute of Nuclear Physics, Cracow (Poland). Mar 1989. 26p. Order Number DE90639194. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Zero and finite temperature quark matter is studied in a chiral chromodielectric model with quark, meson and chromodielectric degrees of freedom. Mean field approximation is used. Two cases are considered: two-flavor and three-flavor quark matter. It is found that at sufficiently low densities and temperatures the system is in a chirally broken phase, with quarks acquiring effective masses of the order of 100 MeV. At higher densities and temperatures a chiral phase transition occurs and the quarks become massless. A comparison to traditional nuclear physics suggests that the chirally broken phase with massive quark gas may be the ground state of matter at densities of the order of a few nuclear saturation densities. 24 refs., 5 figs. (author).

47903 (INT–204/P) **Constraints on muon-catalyzed fusion parameters from (d+d)μ data at low temperatures.** Gula, A. (Institute of Physics and Nuclear Techniques, Cracow (Poland)); Warszynski, P.; Gula, E. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1986. 14p. Order Number DE90639197. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

It is argued that investigation of (d+d)μ fusion in deuterium targets at temperatures T> approx. 40 K provides a unique opportunity of obtaining unambiguous constraints on muon-catalyzed fusion parameters important for comparison with theory. The existing experimental data at T=31-35 K are analysed and the ensuing constraints are presented and discussed. 33 refs., 2 figs. (author).

47904 (JINR-E–4-89-110) **Nucleon pairs as the building blocks of a nucleus.** Trajdos, M. (Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland). Inst. Fizyki); Zajac, K. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 14p. Order Number DE90639185. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The effects induced by the interplay isovesctor and isoscalar components of the residual nucleon interactions were studied in the model based on six bosons: $s_\mu{}^+$ with J=0, T=1, μ=O,$\pm$1 and $p_\mu{}^+$ with J=1, μ=0, $\pm$1, T=0. Low-lying energy levels, E2-transitions, p-boson structure of eigenstates, percentage of α clusters, (p,t) reactions and α elastic scattering were searched in even-even $^{156-166}Dy$ and N=92, Z=56-58 nuclei. 18 refs.; 8 figs.; 1 tab.

47905 (OUP–90-05) **Choice of single-particle potential and the convergence of the effective interaction.** Hjorth-Jensen, M. (Oslo Univ. (Norway). Fysisk Inst.); Osnes, E.; Muether, H.; Schmid, K.W. Oslo Univ. (Norway). Fysisk Inst. Feb 1990. 17p. Order Number DE90639198. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The convergence of the expansion for the effective interaction is studied considering as example the shell model for the nuclei ^{18}O and ^{18}F. In this work the effective interaction is computed through third order in the Brueckner G matrix, using both a harmonic-oscillator (HO) basis and a Brueckner-Hartree-Fock (BHF) basis. The significant differences in the convergence behavior of the effective interaction in these two cases are reported. The results indicate that the choice of the BHF single-particle potential facilitates the convergence of the effective interaction in low-orders of the expansion, whereas the HO results exhibit a non-convergent behavior. The implications for the HO approach are discussed. All calculations have been performed considering a modern version of the Bonn one-boson-exchange potential for the nucleon-nucleon interaction. 23 refs., 4 figs., 2 tabs.

47906 (OUP–90-11) **Evidence for leading mesons in anti p^{4}He reactions at 0.6 GeV/c incident momentum: CERN project PS-179.** Breivik, F.O. (Oslo Univ. (Norway). Fysisk Inst.); Haatuft, A.; Halsteinslid, A. LEAR collaboration. Oslo Univ. (Norway). Fysisk Inst. May 1990. 13p. Order Number DE90639199. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In a previous report, evidence has been shown for leading mesons in anti p Ne - reactions at 0.6 Gev/c incident momentum. In this report evidence is shown for leading mesons in anti p ^{4}He reactions at the same incident momentum, based on data from the same detector. In anti p Ne - reactions, only kaons are observed as leading mesons in K° s-events, and only pions are observed as leading mesons in Λ°-events. In anti p He - reactions this is not longer true, since also pions behave as leading mesons in K° s-events. 5 refs., 9 figs.

47907 (UM-P–89/40) **Spin-flip isovector giant resonances from the ^{90}Zr (n,p) ^{90}Y reaction at 200 MeV.** Raywood, K.J. (Melbourne Univ., Parkville (Australia). School of Physics); Spicer, B.M.; Yen, S. Melbourne Univ., Parkville (Australia). School of Physics. 1989. 47p. Order Number DE90639200. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Doubly differential cross sections of the reaction ^{90}Zr(n,p)^{90}Y have been measured at 200 MeV for excitations up to 38 MeV in the residual nucleus. An overall resolution of 1.3 MeV was achieved. The spectra show qualitative agreement in shape and magnitude with recent RPA calculations; however all of the calculations underestimate the high excitation region of the spectra. A multipole decomposition of the data has been performed using differential cross sections calculated in the DWIA. An estimate of the Gamow-Teller strength in the reaction is given. The isovector spin-flip dipole giant resonance has been identified and there is also an indication of isovector monopole strength. 39 refs., 16 figs., 1 tab.

6540 Radiation and Shielding Physics

47908 (DOE/OR/00033–T443) **Measurement of radial ionization probability in microscopic volumes for 2.90 and 3.79 MeV alpha particles.** Hamby, D.M. North Carolina Univ., Chapel Hill, NC (USA). 1989. 217p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-76OR00033. Order Number DE90017509. Source: NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Material subjected to a uniform field of radiation receives a uniform absorbed dose on a macroscopic scale, but it is quite possible to have large variations in energy density when individual small volumes of that medium are examined. These fluctuations are of importance in microscopic sites since it is likely that some volumes will absorb large quantities of energy. Cellular mutations or transformations take place if the energy density within subcellular target volumes exceeds some threshold. Gas-filled proportional counters are routinely used to experimentally measure energy deposition in such small volumes. However, in microscopic sites less than a few hundred nanometers in diameter (approaching the size of sensitive biological "targets") the proportional counter is no longer useful for measurements of energy deposition. In order to determine energy deposition in nanometer size volumes, Monte Carlo computer programs have been written to generate (through the use of interaction cross- section data) three dimensional charged particle track structures which can be analyzed by additional computer codes to obtain distributions of energy deposition events on a microscopic scale. A parallel-plate avalanche counter capable of simulating microscopic volumes has been constructed and housed in a way that permits detection of ionizations at any given distance from the path of a charged particle. Measurements have been performed to determine the function of ionization probability versus distance from an alpha particle track. Data have been collected for 2.90 and 3.79 MeV alpha particles passing simulated spherical volumes of 44 nm radius at impact parameters from zero to about 100 nanometers. The ionization probability functions can be compared to functions with identical parameters obtained from Monte Carlo computer calculations in an attempt to strengthen the validity of the computer codes.

47909 (INP–1442/AP) **Fundamental decay constant of thermal neutron flux in the two region spherical system.** Woznicka, U. Institute of Nuclear Physics, Cracow (Poland). 1989. 24p. Order Number DE90639183. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The fundamental decay constant of the thermal neutron flux is calculated for the two-region spherical system as a function of external dimensions and/or the macroscopic transport cross section of the inner sphere. The behaviour of the curves is presented in figures for different parameters (thermal neutron parameters of both media and its dimensions). The influence of the thermal energy distribution on the neutron parameters is taken into account. 2 refs., 7 figs., 3 tabs. (author).

6550 Medical Physics

Refer also to citation(s) 47872

47910 (BIR–18, pp. 143-146) **Technical and dosimetric aspects of quality control in mammography.** Zoetelief, J. (Radiobiological Inst. TNO, Rijswijk (Netherlands)); Wit, N.J.P. de; Broerse, J.J. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Mammography is an effective method for early detection of breast cancer. Before screening programmes using mammography are implemented, a risk (financial cost)/benefit analysis has to be made and a quality-control programme for the technical and dosimetric aspects has to be adopted. This should include daily checks on the film processing and the total mammography procedure. The installation of a mAs meter is essential for daily checks and can be used for determination of the absorbed dose. Accurate determination of the tube voltage is essential with regard to absorbed dose variations. The focal spot size should be measured rather than relying on the value specified by the manufacturer. The determination of the focal charge (mAs) value for actual radiographs of female breasts combined with a measurement of the compressed breast thickness provides information on the absorbed dose values for actual radiographs. An approximately 50 mm thick poly(methyl methacrylate) phantom can be used for determination of absorbed dose in mammography. (author).

47911 (BIR–18, pp. 146-149) **A system for the assessment of patient dose in computed tomography scanning.** Mott, D.J. (Christie Hospital and Holt Radium Inst., Manchester (UK)); Jones, A.P. British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A system of assessing the radiation dose to organs from a series of computed tomography (CT) sections has been developed. It uses an extension of the Computed Tomography Dose Index (CTDI) and a series of scatter factors. Attempts to correlate clinical measurements of eye dose for a variety of CT examinations with measured values of CTDI, led to the development of the present method. This is based on the premise that, for a correctly adjusted collimator system, the primary and scattered radiation dose to a

point from a slice of width w is the same as that from two contiguous sections of width w/2. Organ locations are not generally known to much better than 1 cm. This gives rise to the concept of the centimetre section dose (CSD), which is the average dose to an organ or structure within the scanned area from a series of contiguous sections that encompass 1 cm. From experimental measurements on phantoms, the CSD to the surface was calculated for a range of slice widths and found to be independent of the slice width. When applied to the clinical data, the integral scatter factor at 1 cm intervals could be inferred. The data requirements are that the slice dose profile be measured by an array of TLD rods with sufficient coverage to measure the scatter up to 10 cm away from the slice. (author).

47912 (BIR–18, pp. 138-140) **Measurement and quality control of the radiation output of X-ray tubes.** Aalbers, A.H.L. (Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands)). British Inst. of Radiology, London (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development; Commission of the European Communities, Brussels (Belgium). Directorate General for Employment, Social Affairs and Education. 1989. (CONF-8802161–: Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods, Brussels (Belgium), 23-25 Feb 1988; EUR–11620). In *Technical and physical parameters for quality assurance in medical diagnostic radiology: Tolerances, limiting values and appropriate measuring methods.* Source: Available from The British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Variation of the X-ray output affects the image quality and the radiation dose to the patient in diagnostic X-ray examinations. The radiation output of an X-ray tube is a function of filtration, waveform, tube voltage (kV_p), current (mA) and exposure time(s). The assessment and control of the performance characteristics of X-ray generators and tubes is an essential part of a quality-assurance programme for physical parameters of radiological equipment. In this paper, attention is focused on the measurement of the radiation output in order to evaluate the performance of the X-ray tube and generator system. An ionometric method used to assess the consistency of radiation output and the variation of tube output with kV_p and mA settings is described. The precision and accuracy achievable with the measurement technique described are discussed in relation to requirements and limitations of the quality-control parameter being measured. Use of a calibrated ionization chamber, carried out under well defined measurement conditions, provides a simple and reliable means to monitor the radiation output of X-ray tubes. (author).

47913 (CDTN-DERL-PD–006/02.82) **Radiometric survey in the sites of Regional office in Fortaleza, research gallery and camp in Itataia, CE (Brazil).** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Feb 1982. 28p. (In Portuguese). Order Number DE90639755. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The radiometric survey in Regional officer sites in Fortaleza, Brazil, research gallery and camp in Itataia is presented. The measurings to be done, the instrumentation used and results obtained are described as well as the conclusions and recommendations. (C.M.).

47914 (CDTN-DERL-PD–016/81) **Radiological protection program for Pocos de Caldas industrial complex.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 29 May 1981. 31p. (In Portuguese). Order Number DE90639749. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Procedures and routines introduction that implicate rules performance of radiological protection suitable to Pocos de Caldas Industrial Complex sites are presented. (C.M.).

47915 (CDTN-DERL-PD–022/83) **External individual monitoring service by dosimetric films from CDTN/NUCLEBRAS - First verification.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Nov 1983. 37p. (In Portuguese). Order Number DE90639756. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The individual monitoring service by dosimetric films of CDTN, its organization, administrative and technical procedures and quality control are described. (C.M.).

47916 (CDTN-DERL-PD–022/85) **Environmental monitoring program of CDTN.** Ferreira, E.G. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Sep 1985. 54p. (In Portuguese). Order Number DE90639757. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

This environmental monitoring program of CDTN aim to do a survey that permit to verify if the radioactive wastes release by CDTN agree with basic rudiments of radioprotection, evaluate the environmental impact, verify the adjustment of using proceedings to effluents control, to evaluate the maximum radiation doses that public persons will be able to get yearly. (C.M.).

47917 (CDTN-DERL-PD–023/80) **Environmental monitoring program to NUCLEMON deposits in Botuxim - Itu.** Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1980. 15p. (In Portuguese). Order Number DE90639758. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An Environmental monitoring program to be executed in routine as caution against a possible contamination in adjacents regions of Radioactive Materials deposits sites of Santo Amaro (USAM)/ NUCLEMON is presented. (author).

47918 (PSI–63) **New etching conditions for CR-39 for neutron dosimetry.** Azimi-Garakani, D. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Boschung, M.; Wernli, C. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Apr 1990. 18p. Order Number DE90638285. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The results of investigations on track density and track size distributions of the PADC/CR-39 track detectors under different etching conditions are presented. The etching conditions are the combinations of chemical etching (CE) and electrochemical etching (ECE) at low and high frequency with different electric field strength and etching times. The results show that under the conditions reported, the 2-step regime (CE + HF ECE) produces larger tracks ($\approx$2 to 3.5 times) than the 3-step (CE + LF ECE + HF ECE), while the track densities are almost the same. These etching conditions were applied to the CR-39 track detectors irradiated with the monoenergetic neutrons in the framework of the EURADOS-CENDOS joint neutron irradiation. The track densities and the size distributions for different neutron energies are reported. The results are well fitted with the previously evaluated response curve and are compared with similar measurements. (author) 5 figs., 3 tabs., 22 refs.

47919 (SIS–1989:2) **Radiation hazards during pregnancy.** Backe, S. Statens Inst. for Straalehygiene, Oslo (Norway). 1989. 33p. (In Norwegian). Order Number DE90639750. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In 1966 the International Commission on Radiological Protection (ICRP) issued a recommendation with the object to protect the embryo and foetus during the first weeks after conception. The recommendations implied that diagnostic X-ray examinations of fertile women should be limited to the first ten days following the onset of menstruation when the examination involved the lower abdomen and pelvis, if the delay caused was clinically acceptable. The reason was that an early pregnancy is most unlikely during this ten days interval. This recommendation has later been known as the "Ten-Days-Rule". The rule has recently been criticised. It has been suggested that its radiation biology foundation is questionable and that the benefit from following the recommended procedure is rather minute and hardly would satisfy any cost-benefit analysis. According to this criticism, several countries have abandoned the "Ten-Days Rule" and given new recommendations for protection of the embryo and foetus in X-ray diagnostics. Based on the current radiobiological knowledge, the radiation protection authorities in the five Nordic countries decided in 1988 to recommend a new code of practice for protection of the embryo and foetus in X-ray diagnostics. This report outlines the current radiobiological basis for the new recommendations. 25 refs., 2 figs., 2 tabs.

47920 (SIS–1990:1) **Natural radiation, radioactive waste and chemical risk determinants.** Christensen, T. (Statens Inst. for Straalehygiene, Oslo (Norway)); Mustonen, R.; Edhwall, H.; Hansen, H.; Soerensen, A.; Stranden, E. Statens Inst. for Straalehygiene, Oslo (Norway). 1990. 174p. (In Norwegian). Order Number DE90639759. Source: NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

Doses from natural radiation to the population in the Nordic countries are summarized, and man-made modifications of the natural radiation environment are discussed. An account is given for the radiological concequences of energy concervation by reduced ventilation. Risks from possible future releases of radioactivity from final depositories of spent nuclear fuel are compared to the risks from present natural radioactivity in the environment. The possibilities for comparison between chemical and radiological risks are discussed. 104 refs., 36 figs., 47 tabs.

47921 (SIS–1990:2) **Doses from external and internal radiation in Norway during the first year after the Chernobyl accident.** Strand, P.; Kjoelaas, G.; Reitan, J.B.; Strand, T.; Berthelsen, T.; Selnaes, T.D. Statens Inst. for Straalehygiene, Oslo (Norway). 1990. 21p. (In Norwegian). Order Number DE90639760. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In this article the estimation of monthly doses from external radiation from internal radiation due to ingestion of contaminated food is reported. The monthly doses is estimated for each municipality in Norway for the first 13 months after the Chernobyl accident (from May 1986 to June 1987). The estimation which has been elaborated from an extensive data material, shows that the dose rates from external radiation due to the Chernobyl fallout were for the country as a whole three times higher in the first month after the accident (May 1986) compared with the twelfth month (April 1987). The doses received from intake of radiocesium through food were small in the first three months, but reached almost the double of the doses from the external radiation the 9th month. The reduction in the dose from external radiation was primarily due to the physical half life of radiocesium and washout. The increase in the doses from radiocesium through intake of food was due to the time required for radiocesium to enter the food chain and the biokinetics of radiocesium in humans. There is no significant correlation between the ground activity levels and the activity levels observed in the food which is consumed in the same area. The average internal dose in the first year after the Chernobyl accident was estimated to 0.110 ± 0.006 mSv and the external dose to 0.070 ± 0.007 mSv as an average for the whole country. 13 refs., 3 figs., 4 tabs.

47922 (SIS–1990:4) **Whole-body counting in the southern parts of Norway after the Chernobyl accident: 1987 - 1989.** Strand, P.; Selnaes, T.D.; Andersson, A. Statens Inst. for Straalehygiene, Oslo (Norway). 1990. 21p. (In Norwegian). Order Number DE90639761. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

After the Chernobyl accident, four groups were selected in order to calculate the doses to the population in Norway. Two of these groups, Lapps from southern parts of Norway and people from the municipality of Oestre Slidre (mostly hunters and reideer breeders) were especially selected because of their dietary habits. Two other groups were randomly selected among people in the municipality of Sel and Oslo. In Sel the radioactive fallout was considerable, while Oslo was only slightly affected. The persons in each group were whole-body counted once a year, and a yearly dose was calculated based on the whole-body countings. The measurements were carried out in the period of March-May in 1987, 1988 and 1989. The dose equivalent calculated for Lapps showed an average of 0.8 mSv/year the first year, 1.6 mSv/year the second year and 1.1 mSv/year the third year. For randomly selected persons in Sel, the doses varied between 0.14 mSv/year and 0.10 mSv/year. Average yearly dose in the group from Oestre Slidre was 0.34 mSv/year, 0.45 mSv/year and 0.55 mSv/year, respectively. The Oslo group had an average of 0.06 mSv/year in 1987. During the three years, the Lapps received their largest body burdens in 1988, while the persons from Oestre Slidre have shown continously rising values. The dose, due to the Chernobyl accident, calculated for the average population in Norway, is between 0.09 mSv/year and 0.15 mSv/year. 7 refs., 6 figs., 7 tabs.

47923 (SRD-R–497) **Health physics source document for codes of practice.** Pearson, G.W.; Meggitt, G.C. UKAEA Safety and Reliability Directorate, Culcheth (UK). May 1989. 44p. Order Number DE90638271. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Personnel preparing codes of practice often require basic Health Physics information or advice relating to radiological protection problems and this document is written primarily to supply such information. Certain technical terms used in the text are explained in the extensive glossary. Due to the pace of change in the field of radiological protection it is difficult to produce an up-to-date document. This document was compiled during 1988 however, and therefore contains the principle changes brought about by the introduction of the Ionising Radiations Regulations (1985). The paper covers the nature of ionising radiation, its biological effects and the principles of control. It is hoped that the document will provide a useful source of information for both codes of practice and wider areas and stimulate readers to study radiological protection issues in greater depth. (author).

6560 Condensed Matter Physics

Refer also to citation(s) 46383, 47152, 47213, 47214, 47291, 47349, 48038, 48039, 48040, 48041, 48042, 48043, 48044

47924 (CBPF-NF–075/88) **Fukui function: the MO viewpoint revisited.** Giambiagi, M.; Giambiagi, M.S. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 7p. Order Number DE90638870. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

It is shown that the density functional definition of the Fukui function leads, when applied to the LCAO-MO formulation, to the familiar density contour maps of the frontier orbitals. (author).

47925 (CBPF-NF–077/88) **Moessbauer studies of ^{57}Fe: YBa_2 Cu_3O_7 at high temperatures.** Saitovitch, E.B.; Azevedo, I.S.; Scorzelli, R.B. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1988. 13p. Order Number DE90638874. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The substitution of Cu by Fe in the $YBa_2(Cu_{1-x}\ Fe_x)_3O_y$ superconductor induces different effects above and below $x = 0.01$, as seen by DC magnetization and Moessbauer measurements, despite the fact that the X-ray diffraction still shows the orthorhombic structure. Two iron species associated with doubles D1 and D2 are assigned to the occupation of Cu1 sites with different oxygen coordination, their isomer shift values are consistent with a Fe^{+4} high spin configuration. The Moessbauer spectra obtained, in air, at fixed temperatures from 25 C until 298 C revealed a clear modification of the relative intensity of D1 and D2 before the formation of the iron species related to the oxygen deficient phase. (author).

47926 (CNIC–00268) **Radiation modification and interaction mechanism of polypropylene and polyethylene by protons and electrons.** Wang Guanghou (Nanjing Univ., JS (China). Dept. of Physics). China Nuclear Information Centre, Beijing, BJ (China). Oct 1988. 17p. (In Chinese). (NU–0002). Order Number DE90637531. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A systematic investigation of radiation effects on isotactic polypropylene (PP) and low-density polyethylene (PE) films by protons and electrons is reported. Electrons can make polyethylene cross-linked and polypropylene crached while protons can improve the PP mechanical properties and deteriorate polyethylene with increasing the irradiation dose. The structural analysis shows that conversion between α and β phases occurs and the crystallinity remains constant in the electron-irradiated polypropylene whereas the network structure is formed by allyl-type radicals in the e^--irradiated polyethylene. The infrared spectra indicate that conformational changes have taken place in the polypropylene under proton bombardment, such as the transition from an ordered to a disordered state in the crystalline region, the formation of double bonds as well as trans-conformations. This leads to the cross-linking between macromolecules of polypropylene at the proper irradiation doses, thus enhancing its mechanical properties. The

cross-linking of polypropylene by proton bombardment observed and its properties may have some potential applications.

47927 (IAEA-TECDOC–529, pp. 181-192) **The conceptual definition of a crisis management system CMDSS for evaluating acceptable countermeasures to reduce ingestion dose after an accidental release of radioactivity.** Schenker-Wicki, A. (Fribourg Univ. (Switzerland). Inst. for Automation and Operations Research). International Atomic Energy Agency, Vienna (Austria). Oct 1989. (CONF-8811331–: Technical committee on user requirements for decision support systems, Vienna (Austria), 28 Nov 1988). In *User requirements for decision support systems used for nuclear power plant accident prevention and mitigation: Report of a technical committee meeting held in Vienna, 28 November - 1 December 1988.* Order Number DE90637030. Source: NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

A typical example for decision making in a crisis situation could be an environmental accident involving extensive radioactive or chemical contamination. Due to the large consequences and the great number of people affected, the selection of best countermeasures to ameliorate the imminent impact is difficult and the political responsibility is enormous. Judging the advantages and disadvantages of a particular action with respect to one or more criteria will be difficult, because the required data will often not be available and the decision makers have to cope with qualitative statements and uncertain factors. Due to stress, uncertainty, information distortion or information overload, decision quality is often negatively affected in a crisis situation and decision makers operating under acute stress are scarcely capable of considering judgment. To help overcome such problems the Institute for Automation and Operations Research at the University of Fribourg has been charged by the Swiss government to design a concept for a Crisis Management Decision Support System CMDSS and to implement a prototype. It should help evaluate the most efficient and acceptable countermeasures after an accidental release of radioactivity allowing for such factors as variable consumption rates, technological processing or dilution with uncontaminated food stuff, for instance. To allow a quick reaction and a clear choice between certain alternatives, special decision-aid-instruments will be used such as filtering techniques, optimization features and outranking methods. The prototype of the designed Crisis Management Decision Support System CMDSS will be established corresponding to the possibilities of a modern computer support. This includes a monitoring and sensoring system, a threat assessment component and all the necessary models to generate and rank the different countermeasures. (Abstract Truncated)

47928 (INIS-mf–12692) **Department F3. Condensed matter research and materials sciences. Progress report 1989: PSI annual report 1989 annex III.** Gaeggeler, H.W. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Lorenzen, R. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Apr 1990. 142p. Order Number DE90638871. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

The report deals with work done during 1989 in the field of muon spectroscopy, neutron scattering, cryogenic detectors, accelerator mass spectrometry, geochemistry, trace elements, aerosol chemistry, heavy elements, cement products, defect physics, irradiation damages in fusion reactor materials, and superconductivity. 135 figs., 15 tabs. 417 refs.

47929 (INIS-mf–12699) **Department F3. Condensed matter research and materials sciences: PSI annual report 1988 annex III.** Gaeggeler, H.W. (ed.) (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jul 1989. 131p. Order Number DE90638872. Source: NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

The report deals with work done during 1988 in the field of muon spectroscopy, neutron scattering, spallation neutron source SINQ, cryogenic detectors, accelerator mass spectrometry, geochemistry, trace elements, aerosol chemistry, heavy elements, cement products, defect physics, irradiation damages in fusion reactor materials, and superconductivity. 111 figs., 19 tabs., 321 refs.

47930 (IPEN-PUB–211) **Texture investigation in aluminium and iron - silicon samples by neutron diffraction technique.** Pugliese, R.; Yamasaki, J.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Sep 1988. 12p. (In Portuguese). Order Number DE90638876. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

By means of the neutron diffraction technique the texture of 5% and 98% rolled-aluminium and of iron-silicon steel used in the core of electric transformers, have been determined. The measurements were performed by using a neutron diffractometer installed at the IEA-R1 Nuclear Research Reactor, in the Beam-Hole n^0. 6. To avoid corrections such as neutron absorption and sample luminosity the geometric form of the samples were approximated to spheric or octagonal prism, and its dimensions do not exceed that of the neutron beam. The texture of the samples were analysed with the help of a computer programme that analyses the intensity of the diffracted neutron beam and plot the pole figures. (author).

47931 (KU-HCOE-FL2-R–90-9) **Numerical simulations of resonant tunneling with the presence of inelastic processes.** Jauho, A.P. (Copenhagen Univ. (Denmark). Fysisk Lab.). Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1990. 11p. Order Number DE90639092. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We describe simulations of resonant tunneling through a time-modulated double barrier potential. The harmonic modulation frequency ω leads to emission and/or absorption of modulation quanta of energy $\hbar\omega$ in close analogy with emission and/or absorption of dispersionless bosons (optical phonons, photons, plasmons etc.). The transmission coefficient shows satellite peaks in addition to the main resonance. Momentum space snap-shots can be used to extract detailed information of the dynamics of the inelastic tunneling processes, such as opening and closing boson mediated resonant channels, their relative importance, and related timescales. (orig.).

47932 (KU-HCOE-FL2-R–90-10) **Elastic and inelastic resonant tunneling in an imperfect superlattice.** Hyldgaard, P. (Copenhagen Univ. (Denmark). Fysisk Lab.); Jauho, A.P. Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1990. 11p. Order Number DE90639091. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We consider tunneling between the two sections of a disrupted superlattice. The energy of the incoming injected carriers can be tuned by changing the emitter to base voltage in a manner similar to the recently reported superlattice transistors. Hence the calculated transmission coefficient, weighted with the energy distribution of the injected electrons, bears direct relevance to measured IV-characteristics. The vertical transport in the unperturbed miniband is described with a tight binding model, and the disruption, which may arise accidentally, or be fabricated by adjusting the growth conditions, is modelled with an additional double barrier. As the emitter to base voltage is varied, the structure exhibits resonant tunelling within the miniband, with a pronounced negative differental resistance region. Further, we evaluate the transmission coefficient in the case where the region connecting the two superlattices couples to dispersionless optical phonons. Optical phonon related satellite features are identified. Finally, the relation of the calculated effects to recent experiments is analyzed. (orig.).

47933 (LA-UR–90-2632) **Nonlinear optical absorption in intrinsic Stark effect superlattices.** Laurich, B.K. (Los Alamos National Lab., NM (USA)); Smith, D.L.; Watkins, D.E.; Sela, I.; Kroemer, H.; Subbanna, S. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9008143–1: Superlattices and microstructures, Berlin (Germany, F.R.), 13-16 Aug 1990). Order Number DE90016466. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have investigated the nonlinear optical properties of a new class of strained-layer superlattices, the intrinsic Stark effect superlattices (ISES). The superlattices consisted of GaInAs/GaAs grown along the (211)B direction. We observed a shift of the excitonic absorption to higher energies (blue shift) with increasing intensity of the transmitted beam. The observed optical nonlinearity was one order of magnitude stronger than the one due to excitonic screening in the (100) oriented reference material. This effect is attributed

to the screening of the internal electric fields by photogenerated carriers. 13 refs., 4 figs.

47934 (LBL–26455, pp. 79) **Theoretical solid-state physics.** Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Some of the focus of the theoretical work was to foster and maintain collaborations with the experimental programs at LBL in high temperature superconductivity. In other areas the theoretical activity ranged from the development of new theoretical tools and approaches to materials development. In the latter category was the exploration of the use of high pressures for creating new systems and the theoretical analyses of data related to existing novel systems. A close collaboration was established with the experimental research group directed by Alex Zettl. Some of the properties of high-temperature superconducting oxides that were examined are (1) the use of neutron diffraction to explore magnetic interactions, (2) transport properties such as resistivity and thermopower, and (3) the oxygen-substituted isotope effect.

47935 (LBL–26455, pp. 79) **Calculation of electronic and structural properties of BC_3.** Tomanek, D.; Wentzcovitch, R.M.; Louie, S.G.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The equilibrium geometry and electronic structure of the compound BC_3 is determined using the ab initio pseudopotential local-orbital approach and the local-density functional formalism. The boron-carbon compound BC_3 is a layered material with graphitic structure, where every fourth carbon atom is substituted by boron. The nearest-neighbor distances are predicted to be 1.42 Å for the C-C bond and 1.55 Å for the B-C bond. A monolayer of BC_3 is found to be a semiconductor, and the observed metallic behavior of the bulk sample arises from interactions between neighboring layers in BC_3 with AA and AB stacking. Based on total-energy calculations, the authors find BC_3 to be less stable than graphite for the structures investigated.

47936 (LBL–26455, pp. 81) **Superconductivity in primitive hexagonal germanium.** Martins, J.L.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors present a first-principles calculation of the electron-phonon coupling constant λ (mass-enhancement parameter) for the primitive hexagonal, high-pressure phase of Ge (75 GPa $<$ p $<$ 105 GPa). Using the calculated value of λ, they estimate the superconducting transition temperature T_c to be in the range of 2 to 7 K. They discuss the contributions to λ from the different phonon modes and its dependence on the phonon frequency, electron-phonon matrix elements, and Fermi-surface nesting. The results are compared with previous calculations for primitive hexagonal Si.

47937 (LBL–26455, pp. 81) **Jellium-model calculations for dimer decays of potassium clusters.** Saito, S.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors have calculated the total energies of n-atom potassium clusters K_n (1 { <=} n { <=} 23) using a jellium-sphere background model for the positive-ion cores and the local-spin-density-functional approximation for the valence electrons. The authors find that the K clusters with exoergic fission channels have low abundances in the experimental mass spectra, indicating the presence of thermal fissions of K_n. Most of the exoergic fissions are found to produce dimers, K_2, as one of the daughter clusters. The authors have studied the dimer decay of K_{10} in an attempt to explain why K_{10} is one of the least abundant clusters in the K_n mass spectra. Two overlapping jellium spheres with constant density are used for the positive back-ground. The energy-barrier height for complete decay from the energy-minimum point is found to be 0.18 eV, which is a reasonable magnitude for thermal decay compared to the experimental temperature. The monomer decay of K_9 and the dimer decay of K_8 are found to have higher barriers.

47938 (LBL–26455, pp. 85) **Surfaces, chemisorption, and theory of solids.** Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The goal of this work is to further basic understanding of the electronic and structural properties of solids and materials systems such as surfaces and interfaces. First-principles quantum mechanical calculations are carried out to obtain a microscopic understanding of realistic systems. The research effort encompasses the study of bulk materials, surfaces, chemisorption systems, and interfaces, and the formulation and development of new theoretical techniques for calculating ground-state and excited-state properties. Current projects include work on surface atomic and electronic structures, structural and vibrational properties of solids, electronic excitation spectra of solids, solid-solid structural phase transformations, and metal clusters.

47939 (ORNL/FTR–3720) **[Meetings on the structure and properties of implanted ceramics]: Foreign trip report, July 11–August 7, 1990.** McHargue, C.J.; Horton, L.L. Oak Ridge National Lab., TN (USA). 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90017313. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The visit to the University Claude Bernard was for the purpose of analyzing data obtained there and at ORNL in a collaborative research program, to exchange samples, to plan further work, and to revise drafts of two manuscripts for publication. One of the travelers served on the jury for the doctoral examination of E. Abonneau. The travelers also attended the NATO-ASI entitled "Diamond and Diamond-Like Films and Coatings" and served on the Organizing Committee.

47940 (ORNL/FTR–3726) **[Small-angle scattering]: Foreign trip report, August 4, 1990–August 18, 1990.** Wignall, G.D. Oak Ridge National Lab., TN (USA). 4 Sep 1990. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016871. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the Eighth International Conference on Small Angle Scattering (SAS) and presented an invited lecture on "Resolution Effects in SAS." At the Post Conference Course on Theory and Practice of SAS he presented lectures on "Instrumental Aspects of Small-Angle Neutron Scattering (SANS)" and "SANS Applications in Polymer Science." Finally, he visited ICI Chemicals and Polymers, Ltd., for discussions on the characterization of industrial polymer systems via SAS methods.

47941 **Saw determination of surface area of thin films.** Frye, G.C.; Martin, S.J.; Ricco, A.J. To Department of Energy, Washington, DC (USA). USA Patent 4,947,677/A/. 4 Aug 1990. Filed date 5 Oct 1988. USA Patent Application 7-253,642. Int. Cl. G01N 15/08. vp. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a method of determining an adsorption isotherm of a thin film using a piezoelectric substrate having a surface. It comprises coating the thin film on the surface of the substrate; applying an adsorbate to the film; generating a surface acoustic wave along the coated surface, the acoustic wavelength of the surface acoustic wave, being greater than the thickness of the film; measuring the change in frequency of the surface acoustic wave to determine the adsorption/desorption isotherm of the adsorbate on the film; and determining the mass/surface area of the film by applying the BET model to the isotherm.

6561 Superconductivity

Refer also to citation(s) 47122, 47185, 47194, 47195, 47219, 47284, 47399, 47854, 47925

47942 (CNIC–00283) **The content measurement of superconducting phase for high temperature superconducting oxide '$YBa_2Cu_3O_{7-x}$'.** Li Xin (Southwest Inst. of Physics, Leshan, SC (China)); Liu Zhaoquan; Li Huanxing. China Nuclear Information

Centre, Beijing, BJ (China). May 1989. 5p. (In Chinese). (SIP–0033). Order Number DE90637631. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The magnetic conversion temperature, diamagnetism temperature point and the relations between the magnetic susceptibility and varying temperature of the $YBa_2Cu_3O_{7-x}$ oxide are measured by using a varied temperature vibrating magnetometer. The content of superconducting phase of the material is also calculated.

47943 (LA-UR–90-2623) **Copper NMR and hole depletion in the normal state of $Y_{1-x}Pr_xBa_2Cu_3O_7$.** MacLaughlin, D.E. (California Univ., Riverside, CA (USA)); Reyes, A.P.; Takigawa, M.; Hammel, P.C.; Heffner, R.H.; Thompson, J.D.; Crow, J.E. Los Alamos National Lab., NM (USA). 1990. 26p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900751–3: 6. international conference on valence fluctuations, Rio de Janeiro (Brazil), 9-13 Jul 1990). Order Number DE90016468. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Normal-state copper NMR spectra and spin-lattice relaxation rates $1/T_1$ have been measured in the planar cuprate system $YBa_2Cu_3O_7$. With Pr doping the Knight shift K decreases and develops a temperature dependence at both plane and chain sites. Analysis of the bulk susceptibility and NMR data indicate that pair breaking and hole depletion both take part in the suppression of the superconducting transition temperature T_c. The Knight shift behavior resembles that in oxygen-deficient $YBa_2Cu_3O_{7-y}$, as does the temperature dependence of $1/T_1$ for plane Cu sites and magnetic field perpendicular to the c axis. This agreement leads to a consistent picture of the role of antiferromagnetic fluctuations in these materials. An analysis of the data in the framework of the phenomenological theory of Millis, Monien, and Pines is given. In the end compound $PrBa_2Cu_3O_7$ the NMR signal from plane Cu sites indicates antiferromagnetic (AF) ordering at a Neel temperature ~280 K, and in the AF state yields an internal field similar to those found in AF $YBa_2Cu_3O_6$ and La_2CuO_4. 32 refs., 7 figs.

47944 (LA-UR–90-2633) **XAFS analysis in the anharmonic limit: Application to Hi-T_c superconductors and ferrosilicates.** Mustre de Leon, J.; Conradson, S.D. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-9008141–2: 6. international conference on XAFS meeting, York (UK), 5-11 Aug 1990). Order Number DE90016720. Source: NTIS, PC A02/MF A01 - OSTI.

The effect of lattice vibrations in XAFS, reflected in the relative motion of atomic pairs, is usually taken into account by the use of a harmonic Debye-Waller factor. However such treatment is known to be invalid in several situations of interest e.g. superionic conductors metals near the melting point, etc. The use of a harmonic treatment in these situations leads to results in conflict with those obtained using diffraction techniques. The effect of small anharmonicity has been discussed by several authors, finding that in some cases the correction of the harmonic Debye-Waller factor by the first few cumulant expression terms suffices to reconcile XAFS and diffraction results. However, even in situations where anharmonicity is moderate or when the single particle potentials used to describe the lattice dynamics of the system exhibit nearby minima the cumulant expansion breaks down. In order to treat the problem of high anharmonicity, we have generalized the formulation for the exact XAFS thermal average in terms of a RDF, to the quantum mechanical regime, and implemented this formulation in the fitting of XAFS data. This approach permits the treatment of highly anharmonic motion that can not analyzed using cumulant expansion of the Debye-Waller factor. 8 refs., 2 figs.

47945 (LA-UR–90-2671) **Fe site occupancy and superconductivity in $Y_{1-z}Ca_zBa_2(Cu_{1-x}Fe_x)_3O_{6+y}$.** Smith, M.G.; Taylor, R.D.; Oesterreicher, H. Los Alamos National Lab., NM (USA). [1990]. 12p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-901004–4: Conference on magnetism and magnetic materials, San Diego, CA (USA), 30 Oct - 2 nov 1990). Order Number DE90016614. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

X-ray diffraction and ^{57}Fe Moessbauer spectroscopy studies show that partial substitution of Ca for Y in $Y_{1-z}Ca_zBa_2(Cu_{1-x}Fe_z)_3O_{6+y}$ ($0.05 \leq z \leq 0.15, 0.003 \leq x \leq 0.20$) result in increased Fe solubility and a larger percentage of Fe occupancy of the Cu(2) plane site (prepared conventionally). Materials with $z > 0.00$ have a slightly depressed superconducting transition onset temperature T_c relative to the $z = 0.00$ compounds. It is also shown that Fe occupancy of the Cu(2) site in $Y_{1-z}Ca_zBa_2(Cu_{1-x}Fe_x)_3O_{6+y}$ can be substantially increased when these materials are treated at high temperatures in inert atmospheres followed by oxygenation at low temperatures. T_c decreases more rapidly in these latter materials compared to the conventionally prepared ones. Implications concerning ordered Fe cluster formation and superconducting pair breaking in the Cu(2) site are drawn. 7 refs., 4 tabs.

47946 (LA-UR–90-2708) **Computation of superconductor critical current densities and magnetization curves.** Hodgdon, M.L. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-901004–2: Conference on magnetism and magnetic materials, San Diego, CA (USA), 30 Oct - 2 nov 1990). Order Number DE90016567. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Using a constitutive law for superconductor hysteresis and the ideas of the critical state model, a system of equations is developed for the critical current density J_c, the equilibrium magnetization M_e, the upper and lower portions, M_U and M_L, of the major hysteresis loop, and their derivatives with respect to the applied field. The constitutive law consists of a differential equation relating the time rate of change of the flux density B to that of the applied field, $\dot{B} = \alpha(H)|\dot{H}|[f(H) - B] + \dot{H}g(H)$, and a rule governing the abrupt changes observed at the turning points of H. For the case presented here in which f, g, and α have analytic forms, the constitutive law yields an easily differentiable expression for the major loop. Hysteresis curves computed from this constitutive law are shown to be in good agreement with experiments. Calculations of the critical current densities and equilibrium magnetization for the case in which the derivatives are neglected, i.e., the Bean model with $J_c \propto M_U - M_L$ and $M_e \propto M_U + M_L$, are compared with J_c and M_e computed using a system of equations that takes into account the first two derivatives of all quantities. Exponential approximations are given for the critical current densities of several samples of Y–Ba–Cu–O at temperatures between 5 K and 60 K. 7 refs., 4 figs., 1 tab.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 47853, 47854, 47865

47947 (CBPF-NF–008/89) **Specific heat of the harmonic oscillator within generalized equilibrium statistics.** Ito, N.; Tsallis, C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 11p. Order Number DE90638743. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Within the generalized equilibrium statistics recently introduced by Tsallis, we calculate the thermal dependence of the specific heat corresponding to a harmonic-oscillator-likes spectrum, namely, $\epsilon_n = \omega(n-\alpha)$, (where $\omega > 0, n = 0,1,2,...$). The influences of q and α are exhibited. Physically inaccessible and/or thermally frozen gaps are obtained in the low temperature region, and, for $q > 1$, oscillations are observed in the high temperature region. The specific heat of the two-level system is also shown. (author).

47948 (CBPF-NF–010/89) **The Christ-Lee model in the framework of the symplectic projector.** Santos, M.A. dos (Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil)); Mello, J.C. de; Pitanga. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 10p. Order Number DE90638744. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

We analyze the Christ-Lee model in the framework of the symplectic projector method. The correspondent Schroedinger quantization procedure is also applied. (author).

47949 (CBPF-NF–012/89) **Stability of relativistic Hartree states.** Kohmura, T. (Tsukuba Univ., Ibaraki (Japan). Inst. of Physics); Miyama, Y.; Nagai, T.; Ohnaka, S.; Providencia, J. da;

Kodama, T. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1989. 23p. Order Number DE90638745. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

It is shown that the Hartree solution of a relativistic hamiltonian of the type considered by Walecka and collaborators is unstable with respect to particle-hole excitations responsible for fluctuations of the nucleon effective mass, unless the negative energy states (Dirac sea) are taken into account and the corresponding renormalization counter terms are properly treated. It is also shown that static properties as well as low frequency dynamical properties are not too much affected by vacuum polarization effects. However, renormalization is crucial for a correct description of high energy processes associated with the creation of scalar mesons or of particle-antiparticle pairs, even if the momentum transfer is small. Polarization effects lead to a reduction of the effective mass of the scalar meson in the medium. (author).

47950 (IFT-P–10/89) **Variational and perturbative schemes for a spiked harmonic oscillator.** Aguilera-Navarro, V.C. (Inter-American Univ. of Puerto Rico, San German (Puerto Rico). Dept. of Mathematics and Physical Science); Estevez, G.A.; Guardiola, R. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). 1989. 24p. Order Number DE90637409. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A variational analysis of the spiked harmonic-oscillator Hamiltonian operator $-d^2/dx^2 + x^2 + l(l+1)/x^2 + \lambda/x^\alpha$, where α is a real positive parameter, is reported in this work. The formalism makes use of the functional space spanned by the solutions of the Schroedinger equation for the linear harmonic-oscillator Hamiltonian supplemented by a Dirichlet boundary condition, and a standard procedure for diagonalizing symmetric matrices. The eigenvalues obtained by increasing the dimension of the basis set provides accurate approximations for the ground-state energy of the model system, valid for positive and relatively large values of the coupling parameter λ. Additionally, a large-coupling pertubative-expansion is carried out and the contributions up to fourth order to the ground-state energy are explicitly evaluated. Numerical results are compared for the special case α=5/2. (author).

47951 (IPP–6/293) **Complete solution of the modified Cherry oscillator problem.** Pfirsch, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Apr 1990. 21p. Order Number DE90519769. Source: NTIS (US Sales Only), PC A03/MF A01.

In 1925, T.M. Cherry presented a simple example demonstrating that linear stability analysis will in general not be sufficient for finding out whether a system is stable or not with respect to small-amplitude perturbations. The example consisted of two nonlinearly coupled oscillators, one possessing positive energy, the other negative energy, with frequencies $\omega_1=2\omega_2$ allowing third-order resonance. In a previous paper, the present author reformulated Cherry's example and then generalized it to three coupled oscillators corresponding to three-wave interaction in a continuum theory like that of Maxwell-Vlasov. Cherry was able to present a two-parameter solution set for his example which would, however, allow a four-parameter solution set, and a three-parameter solution set for the resonant three-oscillator case was obtained which, however, would allow a six-parameter solution set. Nonlinear instability could therefore be proven only for a very small part of the phase space of the oscillators. This paper now gives the complete solution for the three-oscillator case and shows that, except for a singular case, all initial conditions, especially those with arbitrarily small amplitudes, lead to explosive behaviour. This is true of the resonant case. The non-resonant oscillators can sometimes also become explosively unstable, but only if the initial amplitudes are not infinitesimally small. (orig.).

47952 (JINR-R–2-89-290) **Conservation laws for the Korteweg-de Vries equation with a self-consistent source.** Mel'nikov, V.K. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 11p. (In Russian). Order Number DE90638738. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An infinite number of local conservation laws is found for the Korteweg-de Vries equation with a self-consistent source. It is shown that local conservation laws are also valid for the generalization of the initial system of equations pointed out in the paper. The above results have been obtained by investigating the diagonal of the resolvent kernel of the one-dimensional Schroedinger operator. 6 refs.

47953 (JINR-R–5-89-323) **On the existence of the Cauchy problem and the stability of the kink-solutions of the nonlinear Schroedinger equation.** Zhidkov, P.E. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1989. 12p. (In Russian). Order Number DE90638739. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

First, the existence of the solution of the Cauchy problem, whose absolute value difers from the absolute value of the kink-solution by a function from $W_2^1(R)$ is proved if this is valid for the initial value. Then, the stability of the kink-solution with an accuracy to the translation and rotation is proved if the enveloping function is positive. The result is applied to the concrete physical problems. In the proof, the spectral theorem of the self-adjoint differential operator in $L_2(R)$ is used. 17 refs.

47954 (LA-UR–90-2660) **Order and chaos in polarized nonlinear optics.** Holm, D.D. Los Alamos National Lab., NM (USA). [1990]. 19p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-9002140–1: Chaos down under, Sydney (Australia), Feb 1990). Order Number DE90016717. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Methods for investigating temporal complexity in Hamiltonian systems are applied to the dynamics of a polarized optical laser beam propagating as a travelling wave in a medium with cubically nonlinear polarizability (i.e., a Kerr medium). The theory of Hamiltonian systems with symmetry is used to study the geometry of phase space for the optical problem, transforming from C^2 to $S^2 \times (J,\theta)$, where (J,θ) is a symplectic action-angle pair. The bifurcations of the phase portraits of the Hamiltonian motion on S^2 are classified and shown graphically. These bifurcations create various saddle connections on S^2 as either J (the beam intensity), or the optical parameters of the medium are varied. After this bifurcation analysis, the Melnikov method is used to demonstrate analytically that the saddle connections break and intersect transversely in a Poincare map under spatially periodic perturbations of the optical parameters of the medium. These transverse intersections in the Poincare map imply intermittent polarization switching with extreme sensitivity to initial conditions characterized by a Smale horseshoe construction for the travelling waves of a polarized optical laser pulse. The resulting chaotic behavior in the form of sensitive dependence on initial conditions may have implications for the control and predictability of nonlinear optical polarization switching in birefringent media. 19 refs., 2 figs., 1 tab.

47955 (LA-UR–90-2714) **Lobe area in adiabatic Hamiltonian systems.** Kaper, T.J. (California Inst. of Tech., Pasadena, CA (USA)); Wiggins, S. Los Alamos National Lab., NM (USA). [1990]. 22p. Sponsored by U.S. Department of Defense; U.S. DOE Office of Administration and Human Resource Management; National Science Foundation. DOE Contract W-7405-ENG-36. Grant DPP 8968. (CONF-9005237–6: 10. annual conference on nonlinear science: the next decade, Los Alamos, NM (USA), 21-25 May 1990). Order Number DE90016566. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We establish as analytically computable formula, based on the adiabatic Melnikov function, for lobe area in one-degree-of-freedom Hamiltonian systems depending on a parameter which varies slowly in time. We illustrate this lobe area result on a slowly parametrically forced pendulum, a paradigm problem for adiabatic chaos. Our analysis unties the theory of action from classical mechanics with the theory of the adiabatic Melnikov function from the field of global bifurcation theory.

47956 (LA-UR–90-2755) **Prediction and control of chaotic processes using nonlinear adaptive networks.** Jones, R.D.; Barnes, C.W.; Flake, G.W.; Lee, K.; Lewis, P.S.; O'Rouke, M.K.; Qian, S. Los Alamos National Lab., NM (USA). [1990]. 9p. Sponsored by U.S. DOE Office of Administration and Human Resource Management. DOE Contract W-7405-ENG-36. (CONF-9007136–3:

1990 summer workshop on nonlinear and chaotic phenomena in plasmas, solids, and fluids, Edmonton (Canada), 16-27 Jul 1990). Order Number DE90016505. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present the theory of nonlinear adaptive networks and discuss a few applications. In particular, we review the theory of feedforward backpropagation networks. We then present the theory of the Connectionist Normalized Linear Spline network in both its feedforward and iterated modes. Also, we briefly discuss the theory of stochastic cellular automata. We then discuss applications to chaotic time series, tidal prediction in Venice lagoon, finite differencing, sonar transient detection, control of nonlinear processes, control of a negative ion source, balancing a double inverted pendulum and design advice for free electron lasers and laser fusion targets.

47957 (ORNL/FTR–3709) **[Nonlinear optics and nonlinear dynamics]: Foreign trip report, July 27, 1990–August 13, 1990.** Chen, C.H. Oak Ridge National Lab., TN (USA). 28 Aug 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90015975. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler was invited by the Institute of Atomic and Molecular Sciences, Academia Sinica, in Taiwan to give six lectures on nonlinear optics. The participants included graduate students, postdoctoral fellows, research staff, and professors from several research organizations and universities. Extensive discussion followed each lecture. Since both the Photophysics Group at Oak Ridge National Laboratory (ORNL) and Institute of Atomic and Molecular Sciences in Taiwan have been actively participating in nonlinear optics research, the discussions are very beneficial to ORNL programs. The traveler also visited several laboratories at IAMS to exchange research ideas on nonlinear optics.

70 FUSION ENERGY

47958 (AD-A–222420/2/XAB) **Searches for low-temperature nuclear fusion of deuterium in palladium. Technical report, June 1989-May 1990.** Lewis, N.S.; Barnes, C.A.; Heben, M.J.; Kumar, A.; Lunt, S.R. California Inst. of Tech., Pasadena, CA (USA). Dept. of Chemistry. 17 Aug 1989. 8p. Contract N00014-88-K-0482. (TR–7-ONR). Source: NTIS, PC A02/MF A01.

Pub. in Nature, Vol. 340, No. 6234, 525-530(17 Aug 1989).

A series of experiments has been performed to determine whether nuclear fusion processes occur in palladium rods that have been electrochemically charged with deuterium. With a variety of metallurgical pretreatment procedures and different electrolytes, no evidence has been obtained for any excess enthalpy, neutron, gamma ray, tritium or helium production during electrolysis of D2O with palladium cathodes.

47959 (RAL–90-022) **Proceedings of an international symposium on muon catalyzed fusin μCF - 89 held at Keble College, Oxford, 11-13 September 1989.** Rutherford Appleton Lab., Chilton (UK). May 1990. 117p. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Individual papers in these proceedings are indexed separately.

7001 Plasma Research

Refer also to citation(s) 47405, 47777, 47779, 47792, 47863, 47988, 47989

47960 (ANU-PRL-TP–89/13) **Finite element method for resistive plasma stability studies in cylindrical geometry.** Pletzer, A.; Dewar, R.L. Australian National Univ., Canberra (Australia). Research School of Physical Sciences. Jul 1989. 9p. (CONF-8907205–: Conference on computational techniques and applications, Brisbane (Australia), 10-12 Jul 1989). Order Number DE90638975. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

This paper represents a first step in generalising and applying Green's function method to realistic geometries used for fusion plasmas, e.i. a cylindrical plasma with periodic boundary conditions in the axial (z) direction, which models the topology of a toroidal plasma, such as that in a tokamak, but keeps the problem on dimensional. The matching conditions δ_- and δ_+ obtained by this method have proved to be more accurate. The direct method does not converge for a negative Frobenius exponent $\alpha^{(s)}=-1/2+\mu$. A mesh grading in $1/\mu$ around the rational surface ensures the $M_{+,-}{}^{-2}$ convergence of the generalized Green's function method. 6 refs., 2 figs.

47961 (BUM–87) **Stellarator - tokamak configurations.** Berge, G.; Freidberg, J.P. Bergen Univ. (Norway). Dept. of Applied Mathematics. Jan 1990. 51p. Order Number DE90638957. Source: NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The steliarator configuration and tokamak configuration with helical fields have been studied both from an equilibrium and stability point of view. The model was restricted to a surface current model with a sharp boundary between plasma and vacuum. A general derivation of equilibrium and stability based on the Energy Principle is given. Physically the unstable modes are identified as external global modes. Detailed numerical results in different parameter regimes are presented and discussed. Critical β-limits for equilibrium and stability are obtained and in particular it is shown that in certain parameter ranges there exist a high-β as well as a low-β-region of stability. 7 refs., 14 figs.

47962 (CNIC–00234) **Investigation on the projection by a Z-pinch discharge.** Ren Zhaoxing (Academia Sinica, Hefei, AH (China). Inst. of Plasma Physics); Zhang Shuqing; Huang Chaosong; Li Yahong; Tao Deying; Xie Weidong. China Nuclear Information Centre, Beijing, BJ (China). Sep 1988. 10p. (In Chinese, English). (ASIPP–0005). Order Number DE90637548. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A projectile in a barrel can be propelled by thermal pressure and electromagnetic force produced in a Z-pinch discharge plasma. Comparing experimental results with the theoretical model find that the propelling force from the thermal pressure is higher than that from the electromagnetic force, when the muzzle velocity of the projectile is at the order of 100 m/s.

47963 (CNIC–00261) **The error analysis of probe array used for transient RF impedance measurement in ICR heating experiment.** Wang Zhaoshen (Academia Sinica, Hefei, AH (China). Inst. of Plasma Physics); Wang Yamin; Xu Dezheng. China Nuclear Information Centre, Beijing, BJ (China). Dec 1988. 12p. (In Chinese). (ASIPP–0008). Order Number DE90637549. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Probe array used for the measurement of transient RF impedance in ion cyclotron resonance heating (ICRH) experiment often gives erroneous results. The problem is analysed and the results are given. As a solution a mixed system composed of directinal coupler and four probes are proposed to improve the measurement accuracy.

47964 (CONF-901025–5) **Helium removal and transport studies in TEXTOR.** Hillis, D.L. (Oak Ridge National Lab., TN (USA)); Hogan, J.T.; Horton, L.D.; Isler, R.C.; Klepper, C.C.; Mioduszewski, P.K.; Finken, K.H.; Dippel, K.H.; Pospieszczyk, A.; Rusbueldt, D.; Euringer, H.; Wolf, G.H.; Moyer, R.A.; Conn, R.W.; Gray, D.S.; AkaishiOak Ridge National Lab., TN (USA). [1990]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (IAEA-CN–53/G-2-8). From 13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990. Order Number DE90017021. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Experiments demonstrating direct control of the He^{2+} density in a tokamak plasma have been performed in the TEXTOR tokamak with the Advanced Limiter Test-II pump limiter. Helium is injected in a short gas puff from the outside of the plasma, is observed to reach the plasma core, and then is readily from the plasma. Active He pumping is found to be a valuable technique for discriminating the actual He confinement time from τ^*_{He}, which is strongly dependent on recycling. Active charge-exchange spectroscopy is used to

study the exhaust and transport of He^{2+} within the plasma, and the density evolution is modeled with the diffusive/convective transport code, MIST. 8 refs., 3 figs.

47965 (CTH-IEFT-PP–1989-19) **Approximate analysis of the energy balance equation of a burning fusion plasma.** Anderson, D.; Hamnen, H.; Lisak, M. Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. 1989. 32p. Order Number DE90638958. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

An approximate analysis is made of the 1-D thermal balance equation determining the plasma temperature in a fusion reactor plasma. This highly nonlinear transport equation is investigated for equilibrium and stability. Simple approximate equilibrium solutions are found using variational optimization techniques. Comparisons with numerically obtained solutions show good agreement.

47966 (CTH-IEFT-PP–1989-20) **Collisionless two-fluid theory of toroidal η_i stability.** Mondt, J. (Los Alamos National Lab., NM (USA)); Weiland, J. Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. 1989. 29p. Order Number DE90638976. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A collisionless two-fluid theory based on a fourteen-moment generalization of the 'double-adiabatic' equations is developed to lowest order in the Larmor radius parameter, and applied to derive the toroidal η_i stability boundary for all values of the ratio of the density gradient scale length divided by the field curvature length. The present model is an improvement over existing collisional two-fluid models in view of the collisionless nature of the η_i instability, while retaining the advantage over kinetic theory of the practability of mode-coupling simulations. The linear stability boundary, linear growth rate and real frequency agree fairly accurately with draft-kinetic theory.

47967 (CTH-IEFT-PP–1990-05) **Modelling of neutron sawteeth in Tokamaks.** Anderson, D. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics); Hamnen, H.; Lisak, M.; Batistoni, P. Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics. 1990. 16p. Order Number DE90638977. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A model is developed to relate the drop in fusion neutron emission during sawtooth discharges in Tokamaks to the properties of the ion temperature and density sawteeth. In particular, the ion profile characteristics are shown to play an important role. The model determines the ion temperature profile exponent and the central ion temperature drop from the drop in neutron emission and the observed radius of inversion for the electron temperature. An extension is also made to line integrated neutron emission measurements as well as to neutron emission from neutral beam heated discharges where the dominating contribution to the neutron emission comes from beam-plasma reactions.

47968 (DOE/ER/53201–T5) **[Stellarator theory]: Progress report.** Wisconsin Univ., Madison, WI (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53201. Order Number DE90017607. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This report is principally concerned with explaining the progress which has been made in developing and applying our kinetic plasma model, in sufficient detail to demonstrate the main issues involved. At the end of this paper we briefly discuss work we have done in other areas of stellarator theory.

47969 (DOE/ER/53223–145) **[Plasma properties]: Progress report.** New York Univ., NY (USA). Courant Inst. of Mathematical Sciences. [1990]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53223. Order Number DE90017256. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses the confinement of fusion plasma by strong magnetic fields. The effects of MHD instabilities and charged particle transport are investigated. (LSP)

47970 (DOE/ER/53291–1) **Theoretical studies of turbulence and anomalous transport in toroidal confinement devices: Annual report.** Terry, P.W. Wisconsin Univ., Madison, WI (USA). Dept. of Physics. [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER53291. Order Number DE90017606. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The research performed under this grant during the current year has focused on key issues with respect to turbulence and transport in toroidal confinement devices. This work includes theoretical and computational studies of electron thermal confinement which have concentrated on the role of sheared poloidal flow in suppressing turbulence and transport, trapped ion convective cell turbulence and microtearing turbulence; analytical studies of anomalous particle transport and pinch mechanisms, and comparison with experimental measurement; development of the theory of self-consistent radial transport of field-aligned momentum in the tokamak and RFP; and work on other topics (ion temperature gradient driven turbulence, RFP fluctuation theory, coherent structures). Progress and publications in these areas are briefly summarized in this report. 20 refs.

47971 (DOE/ET/53088–56) **Turbulent spectra from three drift-wave interactions.** Terry, P.W.; Horton, W. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Feb 1982. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–56). Order Number DE90016893. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Hydrodynamic equations for the drift-wave instability containing the $\vec{E} \times \vec{B}$ convective nonlinearity are used to show that the three wave interactions lead to temporal chaos with broad-band frequency spectra in the saturated state. 7 refs., 2 figs.

47972 (DOE/ET/53088–436) **m = 1 kink mode for layer widths comparable to the ion Larmor radius.** Berk, H.L.; Mahajan, S.M.; Zhang, Y.Z. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Aug 1990. 45p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–436). Order Number DE90017265. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A kink-tearing eigenmode equation is derived for a slab layer geometry in the limit $m_e/m_i \ll \beta_i \ll L_n^2/L_s^2$ ($m_e/m_i \equiv$ mass ratio, β_i ion beta value, $L_n \equiv$ gradient scale length, $L_s \equiv$ shear length) and when the electron collision frequency is comparable to the eigenfrequency. It is essential for consistency to retain arbitrary ion Larmor radius effects, which are described with the use of the Pade approximation. The asymptotic solution of the inhomogeneous eigenvalue problem is obtained using simple approximations to the eigenfunction. A dispersion relation duplicates previously derived results when a Lorentzian conductivity model is used for electrons, while a new dispersion relation is obtained if electrons are described by kinetic dynamics. The dispersion relation is analytically and numerically investigated. The numerical results are compared to a more complicated and presumably more "rigorous" asymptotic expression. It is shown that this asymptotic expression requires quite small value for $(m_e/m_i)\beta_i$ for accuracy. A fitting formula is found that is more accurate than the asymptotic formula for moderate values of $(m_e/m_i)\beta_i$. The dissipationless dispersion relation is discussed and it is shown that local shear at the q = 1 surface can have a stronger effect than the value of $\delta\hat{W}_c$ on the system's stability properties.

47973 (DOE/ET/53088–443) **Unified theory of ballooning instabilities and temperature gradient driven trapped ion modes.** Xu, X.Q. (Texas Univ., Austin, TX (USA). Inst. for Fusion Studies); Rosenbluth, M.N. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Aug 1990. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–443). Order Number DE90017091. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A unified theory of temperature gradient driven trapped ion modes and ballooning instabilities is developed using kinetic theory in banana regimes. All known results, such as electrostatic and purely magnetic trapped particle modes and ideal MHD ballooning modes (or shear Alfven waves) are readily derived from our single

general dispersion relation. Several new results from ion-ion collision and trapped particle modification of ballooning modes are derived and discussed and the interrelationship between those modes is established. 24 refs.

47974 (DOE/ET/53088–444) **Tearing modes in tokamaks with lower hybrid current drive.** Xu, X.Q. (Texas Univ., Austin, TX (USA). Inst. for Fusion Studies); Rosenbluth, M.N. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Aug 1990. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–444). Order Number DE90017090. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In this paper, the effect of current drive on the tearing modes in the semi-collisional regime is analyzed using the drift-kinetic equation. A collisional operator is developed to model electron parallel conductivity. For the pure tearing modes the linear and quasilinear growth rates in the Rutherford regimes have been found to have roughly the same forms with a modified resistivity as without current drive. One interesting result is the prediction of a new instability. This instability, driven by the current gradient inside the tearing mode layer, is possibly related to MHD behavior observed in these experiments. 9 refs.

47975 (DOE/ET/53088–445) **Numerical simulation of ion temperature gradient driven modes in the presence of ion-ion collisions.** Xu, X.Q. (Texas Univ., Austin, TX (USA). Inst. for Fusion Studies); Rosenbluth, M.N. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Aug 1990. 51p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–445). Order Number DE90017092. Source: NTIS, PC A04/MF A01; OSTI; INIS.

Ion temperature gradient driven modes in the presence of ion-ion collisions in a toroidal geometry with trapped ions have been studied by using a 1 2/2 d linearized gyro-kinetic particle simulation code in the electrostatic limit. The purpose of the investigation is to try to understand the physics of flat density discharges, in order to test the marginal stability hypothesis. Results giving threshold conditions of L_T/R_0, an upper bound on k_χ, and linear growth rates and mode frequencies over all wavelengths for the collisionless ion temperature gradient driven modes are obtained. The behavior of ion temperature gradient driven instabilities in the transition from slab to toroidal geometry, with trapped ions, is shown. A Monte Carlo scheme for the inclusion of ion-ion collisions, in which ions can undergo Coulomb collisional dynamical friction, velocity space diffusion and random walk of guiding centers, has been constructed. The effects of ion-ion collisions on the long wave length limit of the ion modes is discussed. 44 refs., 12 figs.

47976 (IPP–4/241) **Investigation of current drive possibilities with the present ICRH system in Wendelstein VII-AS.** Chiu, S.C. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Jan 1990. 8p. Order Number DE90519768. Source: NTIS (US Sales Only), PC A02/MF A01.

With the double antenna configuration, designed for first heating tests on W VII-AS, a maximum driven current of 390 A/MW coupled can be expected when using a frequency of 75 MHz and a phasing of $\pi/2$. (orig.).

47977 (IPP–6/292) **Asymptotic solution of a class of inhomogeneous integral equations.** Croci, R. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Mar 1990. 20p. Order Number DE90519767. Source: NTIS (US Sales Only), PC A03/MF A01.

The purpose of this paper is to derive the asymptotic solutions to a class of inhomogeneous integral equations which reduce to algebraic equations when a parameter η goes to zero (the kernel becoming proportional to a Dirac δ-function). This class includes the integral equations obtained from the system of Vlasov and Poisson equations for the Fourier transform in space and the Laplace transform in time of the electric potential, when the equilibrium magnetic field is uniform and the equilibrium plasma density depends on ηx, with the coordinate z being the direction of the magnetic field. In this case the inhomogeneous term is given by the initial conditions and possibly by sources, and the Laplace transform variable ω is the eigenvalue parameter. (orig.).

47978 (IPP–III/147) **Determination of impurity concentrations and Z_{eff} by VUV spectroscopy on ASDEX.** Janeschitz, G.; Ran, L.B.; Fussmann, G.; Krieger, K.; Steuer, K.H. ASDEX Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Nov 1990. 71p. Order Number DE90519771. Source: NTIS (US Sales Only), PC A04/MF A01.

The impurity concentrations and corresponding Z_{eff} contributions as well as the dilution of the deuterium background plasma in ASDEX are determined by VUV spectroscopy. The methods used are described in detail. We describe the absolute calibration of our VUV survey spectrometer with two different calibration sources, as well as our ZEDIFF time-dependent transport code, used for interpreting the spectroscopic measurements. The assessed spectroscopic Z_{eff} compares quite well with the bremsstrahlung Z_{eff} as demonstrated for a number of representative ohmically and additionally heated discharges. In order to obtain these results readily on a shot-to-shot basis at the end of each discharge, a simplified fast evaluation method is introduced. This fast analysis method yields the central impurity concentrations, the central Z_{eff} contributions, and the dilution of the deuterons. Again, the results from the fast analysis method agree well with those from our extended transport code treatment and with the bremsstrahlung Z_{eff}. (orig.).

47979 (IPP–III/157) **Determination of the effective charge number of plasma ions from bremsstrahlung in the near infrared.** Engelhard, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Mar 1990. 78p. (In German). Order Number DE90519770. Source: NTIS (US Sales Only), PC A05/MF A01.

The ASDEX Thomson scattering apparatus measures the scattered light of the laserbeam (λ=10640 A) in the near infrared to obtain density and temperature profiles. Furthermore this kind of apparatus can be used to analyse plasma radiation for determining radial Z_{eff} profiles, as has been demonstrated at ASDEX for the first time. This method provides correct results, if the measured plasma radiation consists almost completly of bremsstrahlung. But besides bremsstrahlung the plasma emits recombination and line radiation. As shown by theoretical deliberations, recombination radiation is negligible, but line radiation can't be excluded. Therefore a spectral resolved measurement was performed, which made it possible to choose those of the different spectral measuring ranges of the Thomson scattering apparatus which are influenced least by line radiation. Furthermore the obtained results enables to allow for the remaining line radiation in order to get a radial profile of bremsstrahlung. This profile and the data of the Thomson scattering apparatus is used to determine Z_{eff}. The statistical errors are less then 10% in the plasma centre. There is a good agreement between Z_{eff}-profiles obtained by bremsstrahlung and the results of the charge exchange recombination spectroscopy. (orig.).

47980 (LRP–396/90) **Influence of triangularity and plasma profiles on ideal-MHD beta limits.** Schultz, G. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)); Bondeson, A.; Troyon, F.; Roy, A. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Feb 1990. 24p. Order Number DE90637574. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Ideal-MHD stability calculations are presented to show the effect of triangularity δ on the beta-limit for plasmas of NET/ITER type with ellipticity κ=2 and aspect ratio A=3.7. Two different types of beta-optimisations have been made to clarify the influence of the equilibrium profiles. In the first set of optimisations, current profiles that are flat in the central region are prescribed, and the pressure profile is optimised. The resulting pressure profiles are broad and triangularity only has a weak influence on the beta-limit. In the second set, more peaked pressure distributions are prescribed and the current profile is optimised. For peaked pressure profiles, triangularity has a clear, positive effect on the beta-limit, and for $\delta \geq 0.4$, the peaked pressure profiles give almost the same beta-limit as the broad profiles. For cross-sections of small triangularity, peaking of the pressure is clearly unfavourable and reasonably high betas can be reached only if the current profile has strong gradients in the central region, or if the central q is significantly above unity. This is needed for stability of Mercier and ballooning modes. In both types of optimisation, the beta-limit is rather weakly dependent on

plasma current for safety factors at the plasma edge in the range of 2.2 to 5. (author) 12 refs., 10 figs.

47981 (LRP–402/90) **Experimental measurements of competition between fundamental and second harmonic emission in a quasi-optical gyrotron.** Alberti, S. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)); Pedrozzi, M.; Tran, M.Q.; Hogge, J.P.; Tran, T.M.; Muggli, P.; Joedicke, B.; Mathews, H.G. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Apr 1990. 14p. Order Number DE90637550. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A quasi-optical gyrotron (QOG) designed for operation at the fundamental ($\Omega_{ce} \simeq 100$ GHz) exhibits simultaneous emission at Ω_{ce} and $2\Omega_{ce}$ (second harmonic). For a beam current of 4 A, 20% of the total RF power is emitted at the second harmonic. The experimental measurements show that the excitation of the second harmonic is only possible when the fundamental is present. The frequency of the second harmonic is locked by the frequency of the fundamental. Experimental evidence shows that when the second harmonic is not excited, total efficiency is enhanced. (author) 6 refs., 5 figs., 1 tab.

47982 (PPPL–2706) **Computation of classical triton burnup with high plasma temperature and current.** Batistoni, P. (ENEA, Frascati (Italy). Centro Ricerche Energia): Barnes, C.W. Princeton Univ., NJ (USA). Plasma Physics Lab. Sep 1990. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90016670. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

For comparison with experiment, the expected production of 14-MeV neutrons from the burnup of tritons produced in the d(d,t)p reaction must be computed. An effort was undertaken to compare in detail the computer codes used for this purpose at TFTR and JET. The calculation of the confined fraction of tritons by the different codes agrees to within a few percent. The high electron temperature in the experiments has raised the critical energy of the tritons that are slowing down to near or above the peak of the D-T reactivity, making the ion drag terms more important. When the different codes use the same slowing down formulas, the calculated burnup was within 6% for a case where orbit effects are expected to be small. Then results from codes with and without the effects of finite radial orbit excursions were compared for two test cases. For medium to high current discharges the finite radius effects are only of order 10%. A new version of the TFTR burnup code using an implicit Fokker-Planck solution was written to include the effects of energy diffusion and charge exchange. These effects change the time-integrated yields by only a few percent, but can significantly affect the instantaneous rates in time. Significant populations of hot ions can affect the fusion reactivity, and this effect was also studied. In particular, the d(d,p)t rate can be 10%–15% less than the d(d,^{3}He)n rate which is usually used as a direct monitor of the triton source. Finally, a finite particle confinement time for the thermalized tritons can increase the apparent "burn-up" either if there is a high thermal deuteron temperature or if there exists a significant beam deuteron density.

47983 (UW-CPTC–90-6) **The evolution of resistive ballooning modes in the banana-plateau collisionality regime.** Sundaram, A.K.; Callen, J.D. Wisconsin Univ., Madison, WI (USA). Aug 1990. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53218. Order Number DE90016672. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The theory of resistive ballooning modes relevant to the banana-plateau collisionality regime is studied using the recently developed neoclassical MHD equations. Employing the ballooning mode formulation and a multiple length scale analysis, a generalized set of poloidal flux surface averaged equations coupling the parallel ion flow velocity $V_{||}$, the vector potential $A_{||}$, and the electrostatic potential ϕ are derived. A particularly simple case in which the parallel sound wave coupling reduces the order of the differential equation in the frequency range $|\omega| \gg \omega_*$, where $\omega_* = sc_s/qR_0$, s is the shear parameter, c_s the sound speed and qR_0 the connection length, is dealt with. The calculations show that a new class of localized pressure-gradient-driven ballooning modes with growth rates varying as $(\upsilon_e + \mu_e)^{1/2}$ is possible, where υ_e is the electron collision frequency and μ_e is the electron neoclassical poloidal flow viscous damping frequency. It is shown that the resistive ballooning modes are sensitive to variations of a parameter η (= | dlnP$_0$/dlnq |) within the tokamak plasma. The enhanced ion polarization and pinch type currents are found to cause stabilization of resistive modes. Further, our model highlights a smooth transition from the Pfirsch-Schlueter to the (neoclassical) banana-plateau collisionality regimes. The relevance of these results to ISX-B experiments is briefly pointed out. 17 refs.

47984 (UWPR–89-2) **Models of plasma confinement and heating in tokamaks.** Callen, J.D. Wisconsin Univ., Madison, WI (USA). Sep 1989. 193p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53218. Order Number DE90016671. Source: NTIS, PC A09/MF A01; OSTI; INIS.

Handwritten manuscript.

This report discusses the following topics: introduction to fusion and tokamaks; tokamak equilibria; ideal MHD stability; resistive MHD instabilities; particle orbits; classical transport in magnetized plasmas; neoclassical transport; models of anomalous transport; auxiliary heating and current-drive; plasma modelling; and tokamak fusion reactor issues and summary.

47985 Current new applications of laser plasmas. Hauer, A.A. (Los Alamos National Lab., NM (USA)); Forslund, D.W.; McKinstrie, C.J.; Wark, J.S.; Hargis, P.J., Hamil, R.A.; Kindel, J.M. pp. 385-436 of Laser-induced plasmas and applications. Radziemski, L.J.; Cremers, D.A. Marcel Dekker Inc., New York, NY (USA) (1989).

This paper reviews several applications of laser produced plasma. The authors deal with the application of laser-generated particles and x-rays. The authors present the progress made in understanding the operation and performance of IR- and UV-laser-triggered spark gaps.

47986 Applications of laser-induced fluorescence spectroscopy for combustion and plasma diagnostics. Lucht, R.P. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility). pp. 623-676 of Laser spectroscopy and its applications: Volume 11. Radziemski, L.J.; Solarz, R.W.; Paisner, J.A. Marcel Dekker Inc., New York, NY (USA) (1987).

This paper discusses laser-induced fluorescence spectroscopy, a sensitive and powerful technique for detecting molecules and atoms, measuring species concentrations and energy-level population distributions, and for probing energy transfer processes in molecules and atoms. The principle of laser-induced fluorescence (LIF) are reviewed. Instrumentation for laser-induced fluorescence measurements is described, and applications of the technique in the areas of combustion and fusion plasma diagnostics are discussed.

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Refer also to citation(s) 47189, 47255, 47358, 47410, 47956, 47985

47987 (CONF-900918–4) **Pellet injector development at ORNL [Oak Ridge National Laboratory].** Gouge, M.J.; Argo, B.E.; Baylor, L.R.; Combs, S.K.; Fehling, D.T.; Fisher, P.W.; Foster, C.A.; Foust, C.R.; Milora, S.L.; Qualls, A.L.; Schechter, D.E.; Simmons, D.W.; Sparks, D.O.; Tsai, C.C. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. symposium on fusion technology; London (UK); 3-7 Sep 1990. Order Number DE90017024. Source: NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Advanced plasma fueling systems for magnetic confinement experiments are under development at Oak Ridge National Laboratory (ORNL). The general approach is that of producing and accelerating frozen hydrogenic pellets to speeds in the kilometer-per-second range by either pneumatic (light-gas gun) or mechanical (centrifugal force) techniques. ORNL has recently provided a centrifugal pellet injector for the Tore Supra tokamak and a new, simplified, eight-shot pneumatic injector for the Advanced Toroidal Facility stellarator at ORNL. Hundreds of tritium and DT pellets were accelerated at the Tritium Systems Test Assembly facility at Los Alamos in 1988–89. These experiments, done in a

single-shot pipe-gun system, demonstrated the feasibility of forming and accelerating tritium pellets at low ^{3}He levels. A new, tritium-compatible extruder mechanism is being designed for longer-pulse DT applications. Two-stage light-gas guns and electron beam rocket accelerators for speeds of the order of 2–10 km/s are also under development. Recently, a repeating, two-stage light-gas gun accelerated 10 surrogate pellets at a 1-Hz repetition rate to speeds in the range of 2–3 km/s; and the electron beam rocket accelerator completed initial feasibility and scaling experiments. ORNL has also developed conceptual designs of advanced plasma fueling systems for the Compact Ignition Tokamak and the International Thermonuclear Experimental Reactor.

47988 (CONF-900918–5) **Fast-wave current drive sytem for DIII-D.** Baity, F.W. (Oak Ridge National Lab., TN (USA)); Goulding, R.H.; Hoffman, D.J.; Ryan, P.M.; Taylor, D.J.; Mayberry, M.J. Oak Ridge National Lab., TN (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 16. symposium on fusion technology; London (UK); 3-7 Sep 1990. Order Number DE90016875. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A four-strap fast-wave current drive (FWCD) antenna array operating in the ion cyclotron range of frequencies has been constructed at the Oak Ridge National Laboratory for use in proof-of-principle experiments on the DIII-D tokamak. The DIII-D facility was selected for the experiments because the high electron temperatures achievable with 2 MW of ECH at 60 GHz and the availability of a wide port recess in the vacuum vessel should allow sufficiently high current drive efficiency for a proof-of principle demonstration. The array consists of four end-fed poloidal loop antennas 11 cm wide on a 23-cm toroidal spacing. The array will be powered by a single 2-MW rf generator. The array can be used for heating over the range of 30 to 60 MHZ or for current drive experiments at 60 MHz. Slotted septa between adjacent loops are used to limit the mutual coupling and to provide support for the double-tiered Faraday shield. Measurements of the $k_{||}$ spectrum in the absence of plasma have been made on a full-scale mockup. Phasing between loops and impedance matching is accomplished by a network of phase shifters and shorted stubs. Initial experiments will be conducted with a relatively simple system which features equal currents in each loop and fixed 90° phasing between loops, but with tuning which is dependent on the mutual coupling. The antenna and tuning system has been analyzed with a coupled lossy transmission line model, so that tuning can be accomplished within a small number of tokamak shots. Subsequent experiments will employ a configuration which features arbitrary phasing between loops, which is independent of the mutual coupling. Algorithms have been developed for operation with either phase or amplitude stability.

47989 (DOE/ER/52122–5) **High-power microwave transmission systems for electron cyclotron resonance plasma heating: Volume 5, Progress report September 1, 1989–August 31, 1990.** Vernon, R.J. Wisconsin Univ., Madison, WI (USA). Dept. of Electrical and Computer Engineering. Aug 1990. 38p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER52122. Order Number DE90017600. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This progress report is for the fifth year of a grant from the US Department of Energy (Contract FG02-85ER52122) for the design, development, and fabrication of ECRF transmission and mode conversion systems to transport microwave power from a gyrotron, or other high power source, to a magnetically confined plasma. (This period is also the second year covered by a three-year renewal proposal submitted in June of 1988.) The development of new and improved components for such systems and underlying theory, where necessary, is the focus of this project. Devising and improving component testing and diagnostic techniques is also an important part of this effort. The development of possible designs for sections of gyrotrons themselves, such as tapers or Vlasov-type launchers, in support of the Varian gyrotron development program is also considered in this work.

47990 (DOE/OR/00033–T438) **Analysis of low energy neutral hydrogen fluxes using an electron cyclotron resonance heated discharge.** Cain, B.L. Illinois Univ., Urbana, IL (USA). 1989. 189p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-76OR00033. Order Number DE90017504. Source: NTIS, PC A10/MF A01; OSTI; INIS; GPO Dep.

This dissertation describes the design, construction, and proof-of-principle verification of a neutral hydrogen flux detection system, based on an ECRH discharge as the neutral flux ionizer. The significant features of the ionizer are its small size and simultaneous excitation of the ECRH mode using a 30 MHz RF driver and relatively small static magnetic fields. Demonstrated is the ability of the ECRH ionizer to ionize $\approx$ 900 eV neutral hydrogen fluxes with subsequent detection in a high resolution energy analyzer. A versatile calibration technique is applied to determine the ionizer efficiency, which additionally gives a variety of elastic scattering and charge exchange cross section results. Also described are the details of a new low energy beam-target interaction research facility, along with the basic techniques required to calibrate many of the system components. The facility has potential applications in areas such as fundamental cross section measurement, plasma diagnostics, beam-plasma interactions, and further beam-target research. 111 refs., 82 figs.

47991 (EGG-FSP–9120) **Beryllium fabrication/cost assessment for ITER [International Thermonuclear Experimental Reactor].** Beeston, J.M. (Beeston (J.M.), Garrison, UT (USA)); Longhurst, G.R.; Parsonage, T. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. Order Number DE90015421. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A fabrication and cost estimate of three possible beryllium shapes for the International Thermonuclear Experimental Reactor (ITER) blanket is presented. The fabrication method by hot pressing (HP), cold isostatic pressing plus sintering (CIP+S), cold isostatic pressing plus sintering plus hot isostatic pressing (CIP+S+HIP), and sphere production by atomization or rotary electrode will be discussed. Conventional hot pressing blocks of beryllium with subsequent machining to finished shapes can be more expensive than production of a net shape by cold isostatic pressing and sintering. The three beryllium shapes to be considered here and proposed for ITER are: (1) cubic blocks (3 to 17 cm on an edge), (2) tubular cylinders (33 to 50 mm i.d. by 62 mm o.d. by 8 m long), and (3) spheres (1–5 mm dia.). A rough cost estimate of the basic shape is presented which would need to be refined if the surface finish and tolerances required are better than the sintering process produces. The final cost of the beryllium in the blanket will depend largely on the machining and recycling of beryllium required to produce the finished product. The powder preparation will be discussed before shape fabrication. 10 refs., 6 figs.

47992 (GAO/RCED–90-113BR) **Nuclear science: Performance of participants in DOE's Inertial Confinement Fusion Program.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. Mar 1990. 39p. Source: US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA).

This report examines the performance of the six participants in DOE's Inertial Confinement Fusion Program. GAO specifically looked into DOE's allegation that the performance of one of the six participants did not meet program expectations. This participant supports the inertial fusion research experiments of the other participants, mainly by providing fusion target components. This report found that performance was mixed. In addition, most of the six participants did not accomplish all of their planned objectives or assigned tasks for various reasons. However, this report believes that comparisons of performance among the six would not be valid because of the different functional role each performs in the program, different degree of difficulty of objectives, and different stages of development of participant programs.

47993 (INT–206/P) **Deadtime effects in the time distributions of muon-catalyzed fusion events.** Gula, A. (Institute of Physics and Nuclear Techniques, Cracow (Poland)); Bubak, M.; Gula, E. Institute of Physics and Nuclear Techniques, Cracow (Poland). 1986. 30p. Order Number DE90639000. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Kinetic formulae describing the experimentally observed time distributions of nuclear fusion reactions catalyzed by negative muons

in mixtures of hydrogen isotopes are derived for a general situation where both detection efficiency and deadtime reduce the number of the registered events. The formulae are a generalization of the kinetic expressions obtained earlier with inclusion of the detection efficiency for zero deadtime. The modification introduced by deadtime is illustrated for the initial cycles of (d+d)μ fusion, for which a comparison with the experimental data is also presented. 26 refs., 5 figs. (author).

47994 (JINR-E-1-89-57) **On the determination of the parameters of the μCF reaction d+d.** Fil'chenkov, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 7p. Order Number DE90639001. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The exact expressions for time distributions of the first detected events of the d+d μCF reaction have been obtained. The earlier obtained theoretical expressions are shown to be valid with the 1% accuracy only for the case of small detection efficiency $\approx$ 1%. 9 refs.; 1 fig.; 3 tabs.

47995 (LA-UR-90-2715) **A current prediction of the ICF gain curve, its uncertainties, and implications for ICF strategy.** Mead, W.C.; Bezzerides, B.; Coggeshall, S.V.; Cray, M.; Fisher, H.N.; Hoffman, N.M.; Magelssen, G.R. Los Alamos National Lab., NM (USA). [1990]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-901025–4: 13. international conference on plasma physics and controlled nuclear fusion research, Washington, DC (USA), 1-6 Oct 1990). Order Number DE90016514. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present our gain predictions for indirect-drive ICF targets, based on current target physics knowledge. In order to understand the uncertainties involved in predicting the performance of future ICF targets, we have constructed a simple model that contains a few basic features of target operation and estimates the possible effects of other complex target processes via simple parametrizations. We evaluate the scalings and uncertainties in the model parameters using current data, detailed calculations, and estimates of some of the underlying target physics processes. We present Monte-Carlo calculations with this model showing the propagation of the estimated uncertainties to the "near-ignition" and "high-gain" regimes. We estimate the probability of success as a function of required target gain and available driver energy, and illustrate using some current facility-planning scenarios. We discuss the role of potential future experiments in constraining currently-uncertain theoretical models.

47996 (LA-UR-90-2887) **KrF laser path to high gain ICF [inertial confinement fusion] laboratory microfusion facility.** Harris, D.B.; Sullivan, J.A.; Figueiro, J.F.; Cartwright, D.C.; McDonald, T.E.; Hauer, A.A.; Coggeshall, S.V.; Younger, S.M. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900918–3: 16. symposium on fusion technology, London (UK), 3-7 Sep 1990). Order Number DE90016439. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The krypton-fluoride laser has many desirable features for inertial confinement fusion. Because it is a gas laser capable of operation with high efficiency, it is the only known laser candidate capable of meeting the driver requirements for inertial fusion energy (IFE) production. Los Alamos National Laboratory has defined a program plan to develop KrF lasers for IFE production. This plan develops the KrF laser and demonstrates the target performance in single-pulse facilities. A 100-kJ Laser Target Test Facility (LTTF) is proposed as the next step, to be followed by a 3 to 10-MJ Laboratory Microfusion Facility (LMF). The LTTF will resolve many target physics issues and accurately define the driver energy required for the LMF. It is also proposed that the technology development for IFE, such as the high-efficiency, high-reliability, repetitively pulsed driver, the reactor, mass production of targets, and the mechanism of injecting targets be developed in parallel with the single-pulse facilities. 11 refs., 4 figs.

47997 (LBL–29094) **Heavy Ion Fusion Accelerator Research (HIFAR) half-year report, October 1, 1989–March 31, 1990.** Lawrence Berkeley Lab., CA (USA). Mar 1990. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (HIFAN–462). Order Number DE90014895. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics: Transverse Emittance Studies on MBE-4; MBE-4 Simulations; Beam Centroid Motion and Misalignments in MBE-4; Survey and Alignment of MBE-4; Energy Analysis of the 5mA MBE-4 Beam; An Improved 10 mA Ion Source for MBE-4; Emittance Degradation via a Wire Grid; Ion Source Development; 2 MV Injector; Electrostatic Quadrupole Prototype Development Activity; Magnetic Induction Core Studies; A Preliminary Consideration of Beam Splitting in Momentum Space; and Status of the Optimization Code HILDA.

47998 (ORNL/TM–11481) **Reaction rate distributions and related data in the FNS Phase II experiments: Comparison of measured and calculated data.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M. Oak Ridge National Lab., TN (USA). Jul 1990. 29p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90014778. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Neutronics parameters including the source neutron spectrum, activation rates, and the tritium breeding in the Li_2O test zone of the Phase II experiment performed at JAERI have been calculated using the Monte Carlo code MORSE using ENDF/B-V transport and reaction cross-sections. Favorable comparisons between the measured and calculated results have been achieved for the $^{27}Al(n,\alpha)$, $^{58}Ni(n,p)$, $^{93}Nb(n,2n)$, and $^{197}Au(n,2n)$ reactions. Calculated $^{58}Ni(n,2n)$ and $^{197}Au(n,\gamma)$ reactions did not agree with measured values within 10–40%. For the Ni reaction the differences may be due to poor data in the ORACT files while discrepancies for the Au data may be due to unknown quantities of hydrogen rich epoxy used to coat the Li_2CO_3 blocks used in the test assembly walls. The calculated tritium breeding in the Li_2O agreed with experimental values within $\pm$ 10% for ^6Li and $\pm$ 15–20% for ^7Li.

47999 (RAL–90-022, pp. 2-9) **Muon-catalyzed fusion theory - introduction and review.** Cohen, J.S. (Los Alamos National Lab., NM (USA)). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Muon-catalyzed fusion (μCF) has proved to be a fruitful subject for basic physics research as well as a source of cold nuclear fusion. Experiments have demonstrated that over 100 fusions per muon can be catalyzed by formation of the dtμ molecules in mixtures of deuterium and tritium. After a brief review of the subject's history, the dtμ catalysis cycle and the principle relations used in its analysis are described. Some of the important processes in the μCF cycle are then discussed. Finally, the status of current research is appraised. (author).

48000 (RAL–90-022, pp. 27-31) **X-ray observation of α-sticking phenomena in muon catalyzed fusion for high density D-T mixture with high T_2 concentration.** Nagamine, K. (Tokyo Univ. (Japan). Meson Science Lab.); Matsuzaki, T.; Ishida, K. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

With the help of a pulsed muon beam, characteristic X-rays for the $(\mu\ \alpha)^+$ atom, formed as a result of alpha sticking phenomena in muon catalyzed fusion were observed for the first time for liquid D_2/T_2 mixtures with a high T_2 concentration. The observed X-ray intensity, with a corrected width due to doppler broadening, is converted to the effective sticking probability which places an upper limit on the energy production capability. (author).

48001 (RAL–90-022, pp. 35-37) **A novel method to determine the initial sticking in dt fusion.** Alper, B. (AEA Technology, Culham (UK)); Anderson, A.N.; Bertin, A. Rutherford Appleton

Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

A series of experiments is in progress to determine the initial sticking coefficient ω_0 of muon catalysed fusion in low density D_2-T_2 gas mixtures. α μ-neutron coincidence and neutron singles from fusions have been observed at gas pressures of 502, 755 and 1509 Torr in a first beam period. We found $\omega_0 < 2.1$ % (90 % conf.) at 2.2×10^{-3} LHD. No proof of epithermal meso-molecule formation was found. (author).

48002 (RAL–90-022, pp. 41) **Measurements of PDμ mesic molecules formation rate in gas.** Balin, D.V. (Leningrad Nuclear Physics Inst., Gatchina (USSR)); Baturin, V.N.; Ilyin, A.I. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Formation rate of muonic molecules pdμ has been measured using a high pressure ionization chamber at various concentrations of deuterium, in equilibrium and non-equilibrium mixtures at temperature 300 K. (author).

48003 (RAL–90-022, pp. 49-51) **Ultra-slow μ^- production via muon catalyzed fusion.** Nagamine, K. (Tokyo Univ. (Japan). Meson Science Lab.). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

A new and novel idea is proposed for the production of slow 10 keV negative muons (μ^-) by using the phenomena of a successive liberation process of μs during muon catalyzed fusion in (dt μ) molecules. By using a thin condensed layer of D_2/T_2 molecules, the energy conversion efficiency from 1 MeV could become more than a few percent. Potential applications towards surface sciences, fundamental atomic physics, etc. are discussed. (author).

48004 (RAL–90-022, pp. 56-58) **(tμ)+d in flight fusion.** Harley, D. (Arizona Univ., Tucson, AZ (USA). Dept. of Physics); Rafelski, J.; Mueller, B. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The direct fusion reaction rate of a tμ incident upon deuteron ions is computed within a modified adiabatic approximation, using the R-matrix formalism to match the nuclear wave functions at the nuclear channel boundaries. We find the direct nonresonant reaction rate to be of the order of 10^5 s^{-1} at very low interaction energies. (author).

48005 (RAL–90-022, pp. 59-61) **Deuteron polarization by muon in (dμ) atom and (dtμ) molecule.** Fukushima, Y. (Fukuoka Univ. (Japan). Faculty of Science); Yahiro, M.; Kamimura, M. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Deuteron polarization energy of a (dμ) atom due to the muon-proton interaction is calculated on the basis of the three-body model for the p+n+μ system. The energy is estimated to be -10.0 meV. This gives a correction to ϵ_{11}=-660.3 meV of a (dtμ) molecule by -2.0 meV. (author).

48006 (RAL–90-022, pp. 62-66) **Below-threshold formation of muonic molecule dtμ - solid hydrogen case.** Fukushima, Kenji (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The muonic molecule dtμ is believed to form mainly through the below-threshold transition when temperatures of a target system, a mixture of hydrogen isotopes, are lower than some hundreds of degrees Kelvin and normalized densities, ϕ = N/No, are higher than a few percents. Understanding the transition is, however, much more difficult than that of Vesman's mechanism and is still far from full comprehension since the many-body correlation effect should properly be taken into account. As a first step to this end, the below-threshold transition in a solid-phase target is examined in detail with some simplification. Phonon excitation induced by the momentum transfer from an incident tμ atom to a participant molecule turns out to enhance the muonic molecule formation rate even at the low temperatures considered. (author).

48007 (RAL–90-022, pp. 67-68) **Spontaneous ionization of the muonic quasi-molecule, [(dtμ)dee].** Armour, E.A.G. (Nottingham Univ. (UK). Dept. of Mathematics); Lewis, D.M. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

A preliminary calculation is carried out of the rate of the dominant (Jυ) = (11) to (Jυ) = (01) transition of the dtμ 'nucleus' of the quasi-molecule, [(dtμ)dee], using the dipole matrix elements for this transition obtained in earlier calculations. Full account is taken, for the first time, of the molecular nature of the quasi-molecule. Reasonable agreement is found with the results of earlier calculations. (author).

48008 (RAL–90-022, pp. 70-71) **Series of resonances in muonic molecules.** Shimamura, Isao (RIKEN, Wako (Japan)). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

For muonic molecules one has to abandon the Born-Oppenheimer approximation, and this can be another source of essential difference between ppe and ppμ. Furthermore, comparison between H^- (pee) and ppμ is even more complicated, because the former has two light particles and the latter two heavy particles; what in well-known is atomic physics for the former system is not necessarily true for the latter system. Nevertheless there is similarity between three-body systems with different constituent particles. This similarity warrants systematic studies of these systems for a deeper understanding of the physics of muonic molecules. The present work is an example of such studies, and pays attention to resonance states, rather than to relatively well-studied bound states. (author).

48009 (RAL–90-022, pp. 81-83) **Muon spectrum and convoy effects after muon catalyzed fusion.** Mueller, B. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Rafelski, H.E.; Rafelski, J. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

We study final state interactions of the muon after muon catalyzed d+t fusion reaction with the α particle and with target matter. The yield of convoy muons, travelling with the α particle

but remaining unbound is calculated to be about 1%. Energy loss in the target may lead to capture of a fraction of these muons into outer shells of the α particle. The final capture probability can be strongly dependent on external parameters, such as density or magnetic field. (author).

48010 (RAL–90-022, pp. 86-87) **Finite size effects on the stopping power of muonic helium.** Takigawa, N. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Mueller, B.; Harley, D. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

We present a formula for the stopping power for particles with internal structure. It reduces to the well known Bethe formula when the internal structure is ignored. In general, however, it takes into account the effects of the finite size and of intrinsic excitations of the particles. We discuss their relevance in the reactivation process of muons in the muon catalyzed D + T fusion. (author).

48011 (RAL–90-022, pp. 88-90) **Accurate binding energies of the J=1, ν=1 states of ddμ and tdμ.** Monkhorst, H.J. (Florida Univ., Gainesville, FL (USA). Quantum Theory Project); Aissing, G.; Bakalov, D.D. Rutherford Appleton Lab., Chilton (UK). May 1990. Grant DE-FG05-85ER13447. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The relativistic shift, the hyperfine splitting, and the corrections to the binding energy due to vacuum polarization and nuclear finite size have been calculated for the J = 1, ν = 1 states of ddμ and tdμ. The corrections have been determined by first order perturbation theory using non-relativistic wave functions. The overall convergence of the calculations is better than 0.01 meV. The accuracy of the total correction to the binding energies is estimated to be $\pm$ 0.5 meV. (author).

48012 (RAL–90-022, pp. 91-92) **The properties of mesic molecular ion ($p^7Be\mu$): Pt. 1: Coulombic interaction.** Belyaev, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR)); Haberzettl, H.; Kuzmichev, V.E.; Sandhas, W. Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The method of surface hyperspherical functions is applied for the calculation of spectrum and size of the mesicmolecular ion (p^7Be μ) in the S- and P-wave states. (author).

48013 (RAL–90-022, pp. 93-96) **Muon catalyzed fusion in plasma state DT mixture.** Takahashi, Hiroshi (Brookhaven National Lab., Upton, NY (USA)). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

We have calculated the rate of formation of dtm molecular in the DT plasma mixture under laser irradiation for the two component plasma. Unlike the case of the D2 molecule, the formation rate due to the electron's electric field decreases as the laser intensity increases. The rates of dtm formation by the electric field of d and t ions are respectively 63 and 77 times larger than that generated by the electron's field in the case of the free particle. These ionic fields are dominant over the electron's electric field and the motion of d and t ions is not greatly affected by the laser field: the rate of formation of dtm molecule by the electric field of ions is not sensitive to the laser field. The slowing down of an atom in the high density and low temperature plasma is substantially reduced as it is in the case of the extremely high temperature plasma. Therefore, the muon sticking factor is small. Thus, a symbiotic system using the muon catalyzed fusion in the high density DT target created by z-pinch type implosion might be viable for pure fusion energy production. (author).

48014 (RAL–90-022, pp. 97-102) **Anomalous neutron emission from metal-deuterium system.** Jones, S.E. (Brigham Young Univ., Provo, UT (USA). Dept. of Physics and Astronomy). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

We have observed anomalous neutron emission from metals containing deuterium, suggesting the occurrence of nuclear fusion at low rates under unusual conditions. The novel phenomenon has been corroborated in collaborative experiments at the Gran Sasso Laboratory and at the Los Alamos National Laboratory. The purpose of this paper is to review experimental evidence that neutron emission is correlated with non-static conditions in metal-deuterium systems, and to posit the conjecture that cold fusion is associated with the formation of metallic deuterium. (author).

48015 (RAL–90-022, pp. 110) **Cold fusion in a confining phase of quantum electrodynamics.** Jandel, M. (Manne Siegbahn Inst. of Physics, Stockholm (Sweden)). Rutherford Appleton Lab., Chilton (UK). May 1990. (CONF-8909262–: International symposium on muon catalyzed fusion μCF - 89, Oxford (UK), 10-13 Sep 1989). In *Proceedings of an international symposium on muon catalyzed fusion μCF - 89 held at Keble College, Oxford, 11-13 September 1989.* Order Number DE90706209. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Energies and interactions of light atomic nuclei and neutrons would change in a hypothetical confining phase of quantum electrodynamics (CQED). Rapid fusion and thermalisation of nuclear particles in the new phase lead to a chemical equilibrium situation where the final fusion product is helium. It is speculated that a small domain of the new phase, embedded in a deuterated metal, can grow in the flow of fusion energy. This conjecture agrees with some of the recently observed cold fusion phenomena. The diffusion time of nuclei and neutrons in a sufficiently large domain of CQED is much longer than the fusion time. Nuclear chemical equilibrium is established before the fusion products reach the surface. The law of mass action together with isospin conservation gives the equilibrium fractions of fusion products. We find that ^{4}He is the most abundant component within a wide range of model parameters. (author).

48016 (SAND–89-2304) **Computational and experimental modeling of runaway electron damage.** Niemer, K.A. (North Carolina State Univ., Raleigh, NC (USA). Dept. of Nuclear Engineering); Gilligan, J.G.; Croessmann, C.D.; Bolt, H.H. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 57p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE90016688. Source: NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Cracking, craters, spotty damage (discoloration), and missing chunks of material have been observed on limiters and along the midplane of tokamak inner walls. This damage is assumed to be due to runaway electron discharges. These runaway electrons have been predicted to range in energy from a few MeV to several hundred MeV. The energy density from the runaway electron discharges ranges from 10 to 500 MJ/m^2 over pulse lengths of 5 to 50 msec. The PTA code package is a unique application of PATRAN, the Integrated TIGER Series, and ABAQUS for modeling high energy electron impact on tokamak first wall and limiter materials. The PTA code package provides a three-dimensional, time dependent, computational code package which predicts energy deposition, temperature rise, and damage on relevant fusion materials from runaway electrons. In this benchmark study, three experiments were modeled to validate the PTA code package. The first and third experiment simulated runaway electrons scattering through a plasma facing surface (graphite) into an internal structure

(copper), and the second experiment tested the thermal and structural response from high energy electron impact on different fusion relevant materials. The PTA calculations compared favorably with the experimental results. In particular, the PTA models identified gap conductance, thermal contact, x-ray generation in materials, and the placement of high stopping power materials as key factors in the design of plasma facing components that are resistant to runaway electron damage. 13 refs., 40 figs., 3 tabs.

48017 (SAND–90-1003C) **Ion coupling efficiency for an extraction applied-B ion diode on the HELIA linear induction adder in positive polarity.** Hanson, D.L.; Cuneo, M.E.; McKay, P.F.; Coats, R.S.; Rosenthal, S.E.; Chavez, J.R.; Stearns, W.F.; Heath, C.E.; Adams, W.G.; Ruscetti, J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009192–13: International symposium on discharges and electrical insulation in vacuum, Santa Fe, NM (USA), 17-20 Sep 1990). Order Number DE90017042. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report on initial experiments to investigate coupling of the four-stage HELIA linear induction accelerator to a uniformly insulated applied-B ion diode in planar extraction geometry. Extraction of an annular ion beam along the diode axis for ion transport and focusing experiments requires that HELIA operate in positive (reverse) polarity, where each of the four cathode voltage adder sections contributes a group of electrons of unique energy and canonical angular momentum to electron flow in a magnetically insulated transmission line (MITL). We show that a number of requirements must be met for efficient production of a uniform high intensity ion beam. An appropriate insulating magnetic field geometry is needed to provide uniform insulation of the anode ion emitting surface and reduce direct electron losses from the cathode MITL region to the anode. A flat diode impedance profile with $Z_D < Z_{SELF-LIMITED}$ is required for efficient MITL power coupling to the diode. Even when the MITL is efficiently insulated upstream of the diode, we observe that some flow electrons are lost directly to the anode along flux lines of the diode insulating magnetic field. These losses slightly reduce overall ion coupling efficiency compared to ion diodes with more conventional MITL power flow, but may also aid in the very rapid turn-on of dielectric flashover ion sources on this diode. In these experiments, we achieved ion coupling efficiencies I_{ION}/I_{TOT} of 60–70% at peak ion power and ion generation efficiencies I_{ION}/I_{DIODE} of 80–90% at peak ion power under optimum conditions. These ion efficiencies, if maintained on higher power extraction diodes, would be adequate for inertial confinement fusion applications including a light ion driver module for the proposed Laboratory Microfusion Facility.

48018 (SAND–90-1167) **Analysis of Textor disruption thermal data.** Russo, A.J. (Sandia National Labs., Albuquerque, NM (USA)); Watkins, J.G.; Finken, K.H.; Dippel, K.H.; Moyer, R.A.; Gray, D. Sandia National Labs., Albuquerque, NM (USA). Aug 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE90016691. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Infrared video thermograms of a portion of the surface of graphite limiters in Textor were taken during several disruptions. Estimates of the deposition power density were made by comparison of the observed temperature histories with those calculated from a numerical thermal conduction model. It was found that the heat flux, at the observed locations, often occurred in sharp submillisecond bursts, the magnitudes of which were much larger than the heat flux density averaged over the whole disruption. 5 refs., 4 figs.

48019 (SAND–90-1491C) **Numerical models of beam dynamics in ion induction linacs.** Freeman, J.R.; Wagner, J.S. Sandia National Labs., Albuquerque, NM (USA). [1990]. 4p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9009200–10: 1990 LINAC conference, Albuquerque, NM (USA), 10-14 Sep 1990). Order Number DE90017043. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have written a numerical simulation code to study beam dynamics in ion induction linear accelerators. The code is used to study axial beam expansion for a particular example. Voltage ramping of the gap reduces the expansion. The code is also used to study the longitudinal instability. The instability grows and saturates after increasing the axial divergence. 3 refs., 5 figs.

48020 (SAND–90-2018C) **Theoretical analysis of a runaway electron suppression device.** Niemer, K.A. (North Carolina State Univ., Raleigh, NC (USA). Dept. of Nuclear Engineering); Gilligan, J.G.; Croessmann, C.D.; England, A.C. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789 ;AC05-84OR21400. (CONF-900918–1: 16. symposium on fusion technology, London (UK), 3-7 Sep 1990). Order Number DE90015992. Source: NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A new runaway electron suppression paddle was designed with the PTA code package to reduce the runaway electron population in the Advanced Toroidal Facility (ATF), Oak Ridge National Laboratory. The PTA code package is a unique application of PATRAN, the Integrated TIGER Series, and ABAQUS for modeling high energy electron impact on magnetic fusion components and materials. By its nature, ATF is susceptible to runaway electron formation and confinement resulting in the production of a high level of hard x-rays near the machine. Four previous stainless steel paddles proved effective in reducing the runaway electron population; however, electrons above 15 MeV have still been observed. Melting and bending were observed in each of the previous paddles, reducing their effectiveness. Scoping experiments are under way to further characterize the runaway electrons in ATF. Data from these experiments will provide insight into runaway electron damage mechanisms. Proposals for the insertion of a new paddle in ATF are being considered. These analyses add to the knowledge of runaway electron damage and will aid in the design of future components to withstand runaway electron discharges in all magnetic fusion devices, including tokamaks. 8 refs., 3 figs., 1 tab.

48021 (SINS–2086/P-5/PP/A) **Investigation of neutron emission from palladium electrode during deuterium oxide electrolysis.** Pawlowicz, W.; Sadowski, M.; Baranowski, J.; Puchalski, Z.; Skladnik-Sadowska, E.; Szydlowski, A. Institute for Nuclear Studies, Otwock-Swierk (Poland). Dec 1989. 14p. Order Number DE90039019. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Scintillation and ^3He detectors were used to detect neutrons emission during electrolysis of heavy water with a palladium cathode. The signals were registered with counters and a multichannel amplitude analyzer. The experiment was continued during about 80 hours while two 6 hour electrolysis runs were carried out. An excess neutron emission rate was observed during the first run. It had the form of a few transient events. The maximum registered signal was about 10 times the average. 9 refs., 5 figs. (author).

48022 (UCRL–101604) **Conceptual design of a target handling cryogenic system for a laboratory microfusion facility.** Lane, M.A. (Lawrence Livermore National Lab., CA (USA)); Siegwarth, J.; Voth, O. Lawrence Berkeley Lab., CA (USA). Jul 1989. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890701–29: International cryogenic materials conference, Los Angeles, CA (USA), 24-28 Jul 1989). Order Number DE90015904. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Proposed direct-drive high gain target designs for a Laboratory Microfusion Facility (LMF) contain liquid or solid DT at 18–23 K. A cryogenic support system is necessary during DT filling of a target, transport from target fill to the experimental area, final target assembly, and delivery into the target chamber. Inside the chamber, heat loads on the target come from self-generated heat of up to 15 mW, plus conductive and radiant heating from the target chamber walls, beam ports and diagnostics of up to 5300 mW for a 10 meter diameter chamber at room temperature. The cryogenic system is required to maintain a cold target for up to twelve hours, and to control the target temperature within 0.5 K. It must also contain minimal structural material inside the chamber during the high gain experiment, to minimize creation of damaging shrapnel when the fusion target explodes. A cryogenic system is proposed which is non-retractable, and cools a target through helium gas convection. It can be integrated with various LMF first wall designs, and with

target alignment systems. The cryogenic system can be constructed mostly of carbon composites which are not activated by neutrons generated from high gain target implosions.

48023 (UCRL-JC-103337) **Cascade and HYLIFE ICF [inertial-confinement-fusion] reactor concept revisions.** Pitts, J.H.; Bangerter, R.O.; Ho, D.D.; Moir, R.W.; Tabak, M. Lawrence Livermore National Lab., CA (USA). 17 Aug 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900918-2: 16. symposium on fusion technology, London (UK), 3-7 Sep 1990). Order Number DE90016479. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We incorporated heavy-ion drivers in the Cascade and HYLIFE concepts, which allow efficient energy coupling to fusion targets with the restricted illumination geometries present. We eliminated vaporization of granular blanket material and destructive shock waves in Cascade by including a solid-lithium x-ray and debris shield around each target. We changed to Flibe rather than lithium in the HYLIFE jet array to eliminate potential fire hazards. We updated the designs. 5 refs., 3 figs., 1 tab.

48024 (UCRL-JC-104774) **Workshop on massively parallel computing in magnetic fusion energy.** Mirin, A.A. (comp.). Lawrence Livermore National Lab., CA (USA). 7 Aug 1990. 28p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-7405-ENG-48. (CONF-9004240-Summs.: Workshop on massively parallel computing in magnetic fusion energy, Williamsburg, VA (USA), 25-26 Apr 1990). Order Number DE90018009. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: Parallel computing at ORNL; massive parallelization of fluid plasma turbulence computations; a parallel implementation of the reduced MHD equations; massively parallel Fokker-Planck calculations; massively parallel Fokker-Planck calculations via Monte-Carlo; gyrokinetic calculations on the connection machine; a parallel 2D electrostatic PIC code for the Mark III Hypercube; particle simulation on the NCUBE concurrent multiprocessor; gyrokinetic simulations on massively parallel computers; and, numerical study of collisionless magnetic reconnection on the connection machine.

48025 Regenerable cryosorption pump with movable physical barrier and physical barrier thereof. Clarkson, I.; Abel, B.; Sedgley, D.W. To Grumman Aerospace Corp., Bethpage, NY (USA). USA Patent 4,907,413/A/. 13 Mar 1990. Filed date 2 Jun 1988. USA Patent Application 7-201,765. Int. Cl. B01D 8/00. 4p. Source: Patent and Trademark Office, Box 9, Washington, DC 20232 (USA).

This patent describes a regenerable cryosorption pump with a movable physical barrier in which the barrier includes a cylindrical body closed at one end and having a circumferential baffle around the open end. The baffle engages a flange on the hydrogen isotope condensing and pumping surface to require all gases entering the pump during normal operation to pass through the hydrogen isotope condensing and pumping surface, thus avoiding bypass of the surface. The barrier is advanced by a bellows system to isolate the hydrogen isotope condensing and pumping surface from the sorbent surface during regeneration and thus ensuring separtion of hydrogen isotopes such as tritium from helium which is sorbed onto the sorbent surface.

99 GENERAL AND MISCELLANEOUS

48026 Nuclear energy in Cuba: An indispensable link toward development. Castro Diaz-Balart, F. (Comision de Energia Atomica, La Habana (Cuba)). *International Atomic Energy Agency Bulletin (Austria),* 32(1): 49-52 (1990).

The paper is a review of progress in the introduction and use of nuclear technology in Cuba in fields of energy, medicine, agriculture, industry, and science.

9901 Management

Refer also to citation(s) 46883, 46909

48027 (INIS-mf-12697) **PSI annual report 1988.** Paul Scherrer Inst. (PSI), Villigen (Switzerland). May 1989. 103p. (In German). Order Number DE90640202. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

The report at hand renders an account of the first year of PSI, which arose from the fusion of EIR and SIN, at the beginning of 1988. The since then more wide-spread field of activity makes a new form for the annual report necessary, because - specially in the case of the SIN reports - a relatively detailed, scientifically technical presentation would be too extensive and not of interest to all its readers. Therefore, a shorter and generally comprehensive report on the activities in each area of research - abridged by relevant information of administrative nature about the institute, is given. Additionally, each of the five areas of research are to submit, in leisurely sequence, a newsletter addressed to professionals. 64 figs., 7 tabs.

48028 (INIS-mf-12698) **PSI annual report 1989.** Paul Scherrer Inst. (PSI), Villigen (Switzerland). Apr 1990. 106p. (In German). Order Number DE90640203. Source: NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

This report, on the second year since the foundation of PSI, gives information on its organisation and management and is as well a short, generally comprehensible presentation of the activities and results of the areas of research. Supplementarily, newsletters of each of the five areas of research appear in the form of annexes I to V, addressed to professionals. 66 figs., 7 tabs.

48029 (RISO-M-2864) **Annual report 1989 Chemistry Department.** Funck, J.; Neve Larsen, Aa.; Larsen, E.; Nielsen, O.J. (eds.). Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Mar 1990. 82p. Order Number DE90640207. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

This report contains a brief survey of the main activities in the Chemistry Department. The names and abstracts of all articles and reports published and lectures given in 1989 are presented. The facilities and equipment are mentioned briefly. The activities are divided into the following groups: radioisotope chemistry, analytical- and organic chemistry, environmental chemistry, polymer chemistry, chemical reactivity, mineral processing, and general. (author).

9902 Mathematics and Computers

Refer also to citation(s) 46488, 46494, 46617, 46622, 46630, 46687, 46726, 46727, 46756, 46757, 46758, 46759, 46760, 46810, 46838, 46856, 46857, 46862, 46865, 46868, 46869, 46871, 46878, 46880, 46889, 46893, 46895, 46896, 46897, 46936, 46937, 46938, 46939, 46940, 46944, 46963, 46967, 46968, 46969, 47052, 47119, 47154, 47155, 47159, 47213, 47214, 47249, 47254, 47258, 47265, 47300, 47319, 47343, 47345, 47374, 47379, 47390, 47427, 47445, 47452, 47470, 47477, 47478, 47479, 47482, 47506, 47543, 47743, 47787, 47791, 47793, 47794, 47795, 47796, 47797, 47853, 47934, 47935, 47936, 47937, 47938, 47955, 47956, 48024

48030 (AD-A-221951/7/XAB) **CSRD parallel service machine enhancement. Final report, 1 December 1988-30 November 1989.** Kuck, D.J. Illinois Univ., Urbana, IL (USA). Center for Supercomputing Research and Development. 30 Nov 1989. 9p. Grant AFOSR-89-0166. Source: NTIS, PC A02/MF A01.

The three major areas in which the Center for Supercomputing Research and Development (CRSD) has performed research involving DOD support are: (I) Parallel Computer Systems Design Evaluation and Simulation Environment; (II) Automatic Restructuring and Concurrent Evaluation of Lisp; and (III) Parallel Iterative Solver for Sparse Nonsymmetric Linear Systems. This proposal requested funds to procure additional processors for the Cedar computer system (KLSD84). These funds enhanced the research capability of CSRD to perform research in the above mentioned areas. Also procured were disk drives to enhance the storage capacity of this system.

48031 (AD-A-222110/9/XAB) **Neural networks. Final technical report.** Johnson, J.L.; Sung, C.C. Battelle Columbus Labs., Durham, NC (USA). Jan 1990. 53p. Contract DAAL03-86-D-0001. Source: NTIS, PC A04/MF A01.

Fundamental properties of neutral networks are discussed and five major models are presented. The emphasis is on the functional interpretation of the describing equations, and includes the nodal activity, learning laws, nonlinear response, stability and overall application areas. Optical implementations by intrinsic nonlinear effects are discussed in detail. Conceptual architectures for the major neural models are presented using optical building blocks for the subsystems. Full concurrent adaptive activity is explicitly included.

48032 (AD-A–222339/4/XAB) **Parallel performance of domain-decomposed preconditioned Krylov methods for PDES with adaptive refinement. Research report.** Gropp, W.D.; Keyes, D.E. Yale Univ., New Haven, CT (USA). Dept. of Computer Science. Apr 1990. 18p. DOE Contract W-31-109-ENG-38. Contracts N00014-86-K-0310. (YALEU/DCS/RR–773). Source: NTIS, PC A03/MF A01.

Preconditioners based on domain decomposition appear natural for the Krylov solution of implicitly discretized partial differential equations on parallel computers. Two-scale preconditioners (involving independent subdomain solves and a global crosspoint system, as well as independent solves over interfaces of lower physical dimension) have been known since the early 1980's to be near optimal in the sense of providing a bounded or at most logarithmically growing iteration count as the mesh is refined. However, overall computational complexity depends on the components of the preconditioner as well as the iteration count. The cost of exact subdomain solves grows superlinearly in arithmetic complexity, and that of the crosspoint system superlinearly in communication complexity. These factors make the preconditioner granularity and the choice of its components problem- and machine-dependent compromises. We present numerical experiments on both shared and distributed memory computers for convection-diffusion problems at modest Peclet (or Reynolds) numbers, without recirculation. Due to the development of boundary layers, these problems benefit from local mesh refinement, which is straightforward to accommodate within the domain decomposition framework in a locally uniform sense, but which introduces load balancing as a further consideration in choosing the granularity of the preconditioner.

48033 (AD-A–222557/1/XAB) **Distributed system fault tolerance using sender-based message logging.** Johnson, D.B.; Zwaenepoel, W. Rice Univ., Houston, TX (USA). Dept. of Computer Science. 1990. 28p. Contract N00014-88-K-0140, Grant NSF-CDA86-19893. Source: NTIS, PC A03/MF A01.

Sender-based message logging supports transparent fault tolerance in distributed systems in which all communication is through messages and all processes execute deterministically between received messages. It uses a pessimistic message logging protocol that requires no specialized hardware. Sender-based message logging differs from previous message logging methods in that it logs each message in the local volatile memory of the machine from which it was sent, thus greatly reducing the overhead of message logging.

48034 (HMI-B–472) **OTTO - the analysing system for spectra ver 9.0.** Menningen, M. Hahn-Meitner-Institut Berlin GmbH (Germany, F.R.). Bereich Schwerionenphysik. Oct 1989. 283p. Order Number DE90519739. Source: NTIS (US Sales Only), PC A13/MF A01.

VAX; Fortran.

OTTO is an interactive command system for the analysis of one-dimensional spectra. OTTO includes basic functions for spectra handling, interactive arithmetic with variables and arrays (formula interpreter), as well as numerous graphic functions. In combination with the general functions more complex dedicated routines (physical routines) are available, e.g. to prepare the measured data or to transform them. There are several program versions including different physical routines. The most important feature of OTTO is a very variable fitting routine (least square fit). A large number of fitting functions is available. Additional functions may be supplied by the user. All operations may be executed also in procedures (command files). The procedure processor is capable of a set of control instructions (jumps, loops, if's). Thus extended procedures may be written in the OTTO command-language. OTTO is written in FORTRAN and was impelemented at VAX computers. (orig.).

48035 (INP–1435/S) **PIMP-user's friendly program for IBM PC compatibles for gamma-rays analysis from germanium detector.** Mietelski, J.W. Institute of Nuclear Physics, Cracow (Poland). 1989. 24p. (In Polish). Order Number DE90640196. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The program for the complex gamma-ray spectra analysis written for IBM PC XT/AT compatibles is presented. The "open" structure of the program makes possible not only a quick automatic analysis but also thorough overlaping-lines separations in a non automatic mode. List of the options is available during the run of the program. The source versions of the main subroutines are presented. 5 refs., 7 figs., 1 tab. (author).

48036 (JINR-R–10-89-40) **High-automation system of film data mathematical processing for the study of nucleon-nucleus interactions on the ES-1061 computer.** Balgansurehn, Ya. (and others); Buzdavina, N.A.; Glagolev, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation. 1989. 9p. (In Russian). Order Number DE90640197. Source: NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

A specialized software system which allows one to essentially reduce the time of experimental data analysis has been developed in order to process film information for nucleon-nucleus experiments. High rate of data processing has been achieved due to complex automation of all stages of processing and removal of program abnormal termination reasons. 9 refs.; 2 figs.; 1 tab.

48037 (LBL–26455, pp. 41-43) **Work in progress.** Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The general method of calculating effective-pair interactions in binary alloys has been extended to surface regions. It is thereby proposed to predict which component segregates to the free surface. Monte Carlo methods are being used to study oxygen/vacancy ordering in the chain plane of $YBa_2Cu_3O_x$. Low-temperature metastable ordered states are found for anisotropic second-neighbor pair interactions ($V_2 \neq V_3$). For the symmetric case ($V_2 = V_3$), proposed by other investigators, no such ordered states are found. An exactly solvable model mimicking the properties of (001) antiphase boundaries in the face-centered-cubic substitutional alloys (Ising or, equivalently, antiferromagnets) with only nearest-neighbor interactions is being developed. It has been already proved exactly that in the thermodynamic limit, antiphase boundaries are unstable at all temperatures. It may be conjectured that antiphase boundaries are unstable for all thermodynamics systems with dimension greater than one. Antiphase boundaries are found at equilibrium in three-dimensional systems with sizes on the order of those used in Monte Carlo simulations of the Ising model. The implication of this unusual size effect are being studied.

48038 (LBL–26455, pp. 80) **Ab initio study of graphite → diamond-like transitions in BN.** Wentzcovitch, R.M.; Fahy, S.; Cohen, M.L.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The variation of the structural energy along two transition paths from the layered to the highly condensed phases of BN was investigated using the first-principles total-energy pseudopotential method. Along the structural paths considered, the symmetries of the initial layered phases have been maintained, leading from the rhombohedral and hexagonal graphitic phases, which differ in their stacking sequences, into the zincblende and wurtzite phases, respectively. Constraining the interlayer distances, the total energies were minimized by allowing the hexagonal rings to stretch and buckle into the chair conformation. The paths obtained in this way have activation-energy barriers approximately 40% smaller than those in graphite → diamond transitions of C, and approximately equal to 0.38 eV/pair for both processes considered when the zero-point-motion energy contribution is neglected. The charge densities indicate that strong bonding between the hexagonal layers occurs only in the final state of the transitions, after the barriers have been crossed, and the structures collapse into the tetrahedrally coordinated phases. From the point of view of electronic structure, at all stages along the transitions, BN displays gaps (calculated within

the local-density approximately) larger than 3.5 eV, a minimum that is reached when the activation-energy barrier is near a maximum.

48039 (LBL–26455, pp. 80) **Theoretical model for the hcp-bcc transition in Mg.** Wentzcovitch, R.M.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Using a first-principles total-energy pseudopotential method, the authors investigate the transition mechanism for a pressure-induced martensitic hcp → bcc transformation that occurs in Mg at pressures around 50 GPa. Two internal structural degrees of freedom are selected, and one lattice is transformed into the other by relaxing these two parameters continuously. One of the parameters characterizes the relative displacement of the hexagonal layers and corresponds to a transverse phonon at the Brillouin-zone edge A in the hexagonal structure. The other characterizes the distortion of the internal hexagonal angles and corresponds to uniform strain along one of the $[0010]_{hcp}$ directions. The interaction between these two distortion modes causes important anharmonic effects in the zone-edge phonon and provides a low-energy path for the structural transition. The small activation barrier at the transition indicates that quantum fluctuations between the two structures could be taking place.

48040 (LBL–26455, pp. 81) **Theory of electronic, vibrational, and superconducting properties of fcc silicon.** Liu, A.Y.; Chang, K.J.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors present a theoretical calculation of the properties of the fcc, high-pressure structural phase of Si. The electronic and phonon properties have been studied, and they predict that the system will be a free-electron-like metal with a very stiff lattice. In addition, they estimate the superconducting transition temperature to be approximately 2 K based on calculations of the electron-phonon coupling constant λ. Comparisons are made with the results of previous calculations for Al.

48041 (LBL–26455, pp. 81) **Determination of diatomic crystal bond lengths using atomic s-orbital radii.** Zhang, S.B.; Cohen, M.L.; Phillips, J.C. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors develop a theory to determine the bond lengths of over 270 AB crystals having ZnS, NaCl, and CsCl structures, including intermetallic compounds. The first-principles pseudopotential s-orbital radius r_s is used, which contains no element-specific adjustable parameters. The good agreement found here between the calculated and measured bond lengths, along with the earlier successful applications of orbital radii for separating structures, illustrates the importance and usefulness of the orbital-radii scheme.

48042 (LBL–26455, pp. 82) **Total dielectric function: Algebraic sign, electron-lattice response, and superconductivity.** Allen, P.B.; Cohen, M.L.; Penn, D.R. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The interaction between two test charges in a solid can be described in terms of a total dielectric function that includes electronic and lattice polarization. Crystal stability requires the eigenvalues of ϵ^{-1} to be $\{ <= \}$ 1. Some implications for superconductivity are discussed. A total dielectric function for the electron-lattice system is derived in the mean-field approximation, and its inverse is explicitly constructed. The low-lying poles of ϵ^{-1} give the correct phonon frequencies as determined by the usual dynamical matrix.

48043 (LBL–26455, pp. 82) **X_1 and X_3 states of electrons and phonons in zincblende-type semiconductors.** Wentzcovitch, R.M.; Cardona, M.; Cohen, M.L.; Christensen, N.E. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Despite the extensive experimental and theoretical characterization of the band structures of III-V zincblende semiconductors, the literature is still ambiguous in classifying the symmetries of the lowest conduction states at the X point in the Brillouin zone of these compounds. The authors present the symmetries of these states obtained by the first-principles pseudopotential and the linear muffin-tin orbital methods and label them consistently for this class of compounds. The authors also point out that analyses of the indirect optical absorption edge structure in compounds with the lowest conduction states at X (e.g., AlAs, AlSb, and GaP) reveal the symmetries of these states in agreement with theoretical predictions. This technique could also be used to determine these symmetries in other indirect-gap compounds or those that acquire an indirect gap $\Lambda \rightarrow X$ under reasonably modest pressures (e.g., GaAs).

48044 (LBL–26455, pp. 82-84) **Diagonalization of large matrices in pseudopotential band-structure calculations: Dual-space formalism.** Martins, J.L.; Cohen, M.L. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Combining iterative methods of calculating the eigenvectors of a Hermitian matrix with a matrix multiplication technique using the fast-Fourier-transform algorithm, the authors present an efficient method of performing total-energy and band-structure calculations in crystals with the plane-wave local-pseudopotential formalism where part of the calculation is performed in momentum space and another part in coordinate space. Significant savings in both computer time and memory are obtained. Results of calculations for molecular hydrogen with matrix sizes as large as 7,200 are presented as an example.

48045 (LBL–26455, pp. 85) **Variational quantum Monte Carlo approach to solids.** Fahy, S.; Wang, X.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The authors have developed a new method of calculating the total energy and other ground-state properties of solids. The method employs nonlocal pseudopotentials in conjunction with the variational quantum Monte Carlo approach. Valence electron correlations are treated using the exact Coulomb interaction with a correlated many-electron wavefunction of the Jastrow-Slater form. The use of pseudopotentials for the electron-ion interaction removes from the problem the large fluctuations of electron energies in the core region that occur in quantum Monte Carlo all-electron schemes. The method is used to calculate the cohesive energy and structural properties of diamond and graphite and the ionization energy and electron affinity of various atoms. The results are in excellent agreement with experiment.

48046 (LBL–26455, pp. 85) **Electron excitations and surface-state energies at semiconductor surfaces.** Hybertsen, M.S.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

A first-principles theory of the quasiparticle surface-state energies on semiconductor surfaces is developed. The surface properties are calculated using a repeated-slab geometry. Many-body effects due to the electron-electron interaction are represented by the electron self-energy operator, including the full-surface Green's function and local fields and dynamical screening effects in the Coulomb interaction. Calculated surface-state energies for the prototypical Si(111):As and Ge(111):As surfaces are presented. The calculated energies and dispersions for the occupied surface states (resonances) are in excellent agreement with recent angle-resolved photoemission data. Predictions are made for the position of empty surface states on both surfaces that may be experimentally accessible. The resulting surface-state gap at Λ for Si(111):As agrees with recent scanning-tunneling-spectroscopy and inverse-photoemission measurements. Comparison of the present results to eigenvalues from the local-density-functional calculation reveals substantial corrections for the gaps between empty and occupied surface states. This correction is found to depend on the character of the surface states involved.

48047 (LBL–26455, pp. 86) **Ab initio calculation of pressure coefficients of band gaps of silicon: Comparison of the LDA and quasiparticle results.** Zhu, X.; Fahy, S.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The pressure coefficients of band gaps of silicon are calculated using a first-principles quasiparticle approach. For comparison, the same quantities are also computed within the local-density approximation (LDA). In both cases, the calculations were performed for volumes corresponding to pressures between 0 and 150 kbar using ab initio norm-conserving pseudopotentials. The electron self-energy in the quasiparticle calculation is obtained using a first-order expansion in the dressed Green's function G and the screened Coulomb interaction W with local fields. The quasiparticle results show a linear dependence of changes in the band gaps on lattice constant, while the dependence on pressure deviates from linearity at high pressure. The LDA band-gap pressure coefficients, obtained using three commonly used exchange-correlation potential forms, are shown to be very close to the quasiparticle values for the whole range of crystal volumes considered. At some of the volumes considered, the LDA band gaps are negative. Both sets of pressure-coefficient results are in very good agreement with available experimental values for Si.

48048 (LBL–26455, pp. 86) **Ab initio study of graphite → diamond-like transitions in BN.** Wentzcovitch, R.M.; Fahy, S.; Cohen, M.L.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

The variation of the structural energy along two transition paths from the layered to the highly condensed phases of BN is investigated using the first-principles total-energy pseudopotential method. Along the structural paths considered, the symmetries of the initial layered phases have been maintained, leading from the rhombohedral and hexagonal graphitic phases, which differ in their stacking sequence, into zincblende and wurtzite phases, respectively. Constraining the interlayer distances, the total energies were minimized by allowing the hexagonal rings to stretch and buckle into the chair conformation. The paths obtained in this way have activation-energy barriers approximately 40% smaller than those in graphite → diamond transitions of C, and approximately equal to 0.38 eV/pair for both processes considered when the zero-point-motion energy contribution is neglected. The charge densities indicate that strong bonding between the hexagonal layers occurs only in the final state of the transitions, after the barriers have been crossed, and when the structures have collapsed into the tetrahedrally coordinated phases. From the point of view of electronic structure, at all stages along the transitions, BN displays gaps (calculated within the local-density approximation) larger than 3.5 eV, a minimum reached when the activation-energy barrier is near a maximum.

48049 (LBL–26455, pp. 86-88) **Spin-orbit interaction effects in zincblende semiconductors: Ab initio pseudopotential calculations.** Li, M.F.; Surh, M.P.; Louie, S.G. Lawrence Berkeley Lab., CA (USA). Jul 1989. In *Materials and Chemical Sciences Division annual report, 1988.* Order Number DE90003301. Source: NTIS, PC A11/MF A01.

Ab initio band-structure calculations have been performed for the spin-orbit interaction effects at the top of the valence bands for GaAs and InSb. Relativistic, norm-conserving pseudopotentials are used with no correction made for the gaps from the LDA. The spin-orbit splitting at Λ and linear terms in the → dependence of the splitting are found to be in excellent agreement with existing experiments and previous theoretical results. The effective mass and the cubic splitting terms are also investigated.

48050 (ORNL/FTR–3715) **[Artificial intelligence, human factors, robotics, and computer simulation]: Foreign trip report, August 2, 1990–August 22, 1990.** Spelt, P.F. Oak Ridge National Lab., TN (USA). 6 Sep 1990. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90016866. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Traveler was invited to participate in information exchange between Oak Ridge National Laboratory (ORNL) and CISC/JAERI on four topics: Artificial Intelligence, Human Factors, robotics, and computer simulation. This exchange took the form of 9 (2-hour) lectures presented by traveler on work done in CS&HF Group, and four presentations by Japanese for traveler's edification. Seven of traveler's lectures were to CISC/JAERI, one to Toshiba Corporation, and one to the AI Steering Committee of JAERI. There was also a presentation by Toshiba Corporation on HF work connected with their Boiling Water Reactor (BWR) control room. Final discussion between traveler and JAERI personnel concerned an umbrella agreement with the US Department of Energy (DOE) permitting researcher exchange similar to nuclear researchers. Conclusions are: the US has definite advantages in most areas of AI progress; the Japanese are creating a Monte Carlo radiation dose calculation simulation which will operate at the level of radiating particles (neutrons) with doses calculated for all major organ systems of humans, and major circuits for robots; they are gaining experience in creating major integrated simulations of human/robot activity in a nuclear reactor; and that it would be advantageous for us to have a formal agreement permitting scientists to visit there for more than 15 days at a time.

48051 (PB–90-248212/XAB) **Pseudorandom number generation on supercomputers. Research memo.** Kleijnen, J.P.C.; Adams, N. Tilburg Univ. (Netherlands). Dept. of Economics. Feb 1989. 27p. (FEW–378). Source: NTIS, PC A03/MF A01.

Pseudorandom numbers generators are essential in Monte Carlo simulation. On supercomputers these numbers should be generated in parallel. Several procedures are evaluated, and one practical procedure is developed.

48052 (PNL-SA–18090) **A representation scheme for fault diagnosis.** Stratton, R.C. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-900793–4: AAAI '90: 8. national conference on artificial intelligence, Boston, MA (USA), 17 Jul - 3 aug 1990). Order Number DE90016291. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Subsequent to developing the conceptual description of a intelligent software system a representation scheme is selected. The knowledge representation scheme constrains the way in which knowledge is represented and executed in a software system. The representation scheme consists of methods for writing down information, organizing information, controlling software execution, and performing inference. This paper discusses a knowledge representation scheme that we are developing for use in building intelligent systems that assist in physical system fault diagnosis. This scheme consists of function and object hierarchies, generalized inference methodologies, and a control scheme that allows for concurrent reasoning during fault diagnosis.

48053 (PNL-SA–18409) **Neural networks and data pipelines.** Melton, R.B.; Barga, R.S. Pacific Northwest Lab., Richland, WA (USA). Jul 1990. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-9007164–1: International systems science society neural networks symposium, Portland, OR (USA), 8-13 Jul 1990). Order Number DE90017141. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discusses the role of neural networks in information systems designed to acquire, manage, analyze, and display large volumes of spatio-temporal data (i.e., "data pipelines"). The nature of data pipelines is outlined and roles for neural networks in pattern recognition and matched filtering, data conversion, and non-parametric modeling are identified. Two examples of applications of neural networks to problems typical of those found in data pipelines are presented.

48054 (PSI–61) **Quantitative characterisation of complexity and predictability.** Badii, R. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)). Paul Scherrer Inst. (PSI), Villigen (Switzerland). Apr 1990. 12p. Order Number DE90638686. Source: NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A measure of complexity for sequentially created symbolic patterns is introduced. The underlying grammatical rules are systematically detected in terms of variable-length prefix-free codewords and arranged on a 'logic' tree. Predictions on the scaling structure of the system are then formulated and compared with the

observation. The discrepancy between the two, evaluated through a generalisation of the information gain, characterises the complexity of the system, relative to the unfolding scheme. (author) 1 fig., 20 refs.

48055 (SAND–89-0864) **Internal design document Tech Control TRAINER.** Malm, B.N.; Cook, W.R.; Gallegos, M.H. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 100p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90014855. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Tech Control TRAINER is a stand-alone computer that runs the Modular Building Blocks (MBB) Tech Control software and emulates the other components of the MBB system to provide a simulation of the Tech Control system. This document describes the internal design of the Tech Control TRAINER. 8 refs., 30 figs., 4 tabs.

48056 (SAND–89-0865) **POC/ET Tech Control Trainer user's guide.** Cook, W.R.; Malm, B.N.; Gallegos, M.H. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 46p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90014856. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Tech Control Trainer is a stand-alone hardware and software package that allows an operator to use a Tech Control system without having real devices attached. The devices and their communication hardware are emulated to provide true Tech Control functionality. The primary purpose of the Trainer is to train operators to use Tech Control. To support this purpose, specialized commands are provided to allow an operator to simulate device failures, thereby preparing the operator to handle unusual situations as well as normal operations. 5 figs., 13 tabs.

48057 (SAND–89-0866) **ECMC Tech Control Trainer user's guide.** Cook, W.R.; Malm, B.N.; Gallegos, M.H. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 27p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90014857. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Tech Control Trainer is a stand-alone hardware and software package that allows an operator to use a Tech Control system without having real devices attached. The devices and their communication hardware are emulated to provide true Tech Control functionality. The primary purpose of the Trainer is to train operators to use Tech Control. To support this purpose specialized device failures, thereby preparing the operator to handle unusual situations as well as normal operations. 4 figs.

48058 (SAND–90-2255C) **Software safety workshop problem: Application of hardware safety principles to software.** Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9010171–2: Workshop on design and assurance for software safety, Las Cruces, NM (USA), 16-18 Oct 1990). Order Number DE90016222. Source: NTIS, PC A02/MF A01 - OSTI; GPO Dep.

More than 20 years ago, a philosophy was developed for the design and analysis of hardware systems to ensure that they would perform in a predictably safe manner, even in severe abnormal environments. This philosophy has been scrutinized and tested during the intervening years, and has proved successful in practice. A requirement guiding the development of the philosophy was that the resulting design must be simple enough to be amenable to analysis. The inherent simplicity is a safety attribute, because complex analyses, such as those represented by fault trees containing hundreds of branches, are extremely susceptible to error. There are many examples where such errors led analysts to believe systems were safe when they were not, with disastrous consequences. The purpose of this workshop problem is to determine whether the principles developed to ensure hardware safety are applicable in any way to safety-critical software systems. It is possible that hardware associations with software will need to be considered, but whether or not this is true is left as an aspect of the investigation. In order to put the ground rules in perspective, it will be necessary to establish some framework.

48059 (SAND–900-0165) **SA3646 characteristic and development report.** Simpson, R.L. Jr. Sandia National Labs., Albuquerque, NM (USA). Jul 1990. 37p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90014858. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report will present the development history, characterization data and the qualification activities for the SA3646. This device is manufactured by SEEQ Technology Inc., with part number LM28C256-250/B and is a 256K Electricity Erasable Programmable Read Only Memory (EEPROM). 14 refs., 25 figs.

48060 (SLAC–368) **Proceedings of the REXX symposium for developers and users.** Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1990. 235p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9006245–: Rexx symposium for developers and users, Stanford, CA (USA), 11 Jun 1990). Order Number DE90016696. Source: NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This report discusses the following topics: REXX 4.0; IBM REXX compiler; the astonishment factor; I/O and environment challenges; object oriented REXX; IBM SAA REXX for OS/2; REXX for UNIX; why REXX died (a retrospective); SLAC use of REXX on VM and VMS; developing fullscreen REXX applications; CMS pipelines; and REXX in three different environments: VM/MVS/OS/2.

48061 (SLAC–370) **A valiant little terminal: A VLT user's manual.** Weinstein, A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1990. 114p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE90016695. Source: NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This paper discusses: an introduction to valiant little terminal (VLT); getting started; the user interface; writing scripts; and troubleshooting.

48062 (SOL–90-11) **Modifying MINOS for solving the dual of a linear program.** Schweitzer, E. Stanford Univ., CA (USA). Systems Optimization Lab. Aug 1990. 48p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research; Electric Power Research Institute; National Science Foundation. DOE Contract FG03-87ER25028. Contract RP8010-09;Grant DMS-8913089;Grant ECS-8906260;Grant N00 Order Number DE90016721. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In solving large-scale programs by Bender's decomposition, it can be advantageous to solve the master and the sub problems via their dual problems. In this report I describe the changes I have made in one of the MINOS files, so MINOS could transform a given primal linear program to its dual, solve the dual and in addition, write and MPS file that contains the dual problem.

48063 (UCRL-CR–104570) **Effects of finite sampling and additive noise on image reconstruction from Radon transform.** Tsujimoto, E.M. (California Univ., Davis, CA (USA)). Lawrence Livermore National Lab., CA (USA); California Univ., Davis, CA (USA). Dec 1988. 65p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016864. Source: NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Radon transform arises naturally in the problem of reconstructing an image or cross section from line integral measurements through a specified object. Each line integral or ray is a sample of the Radon transform of the object and the set of all samples at a particular angle is called a projection or view. Consequently, the set of all possible samples at all possible projections in a particular plane constitutes the two-dimensional Radon transform. Of course, it is impossible to acquire an infinite number of data points for the purpose of image reconstruction. However, with a sufficient set of Radon transform samples, an images can be determined through various Radon transform inversion techniques. From this statement, however, arises the question of just what constitutes a sufficient set of Radon transform samples. Acquiring an insufficient number of samples results in various artifacts in the reconstructed image. On the other hand, taking too many samples utilizes the data inefficiently. Thus, the problem of interest is to determine the optimum number of projections and the optimum number of samples per projection required to adequately represent the Radon transform such that the image can be accurately reconstructed.

The problem of image reconstruction is further complicated if noise is introduced in the projection domain. Noise may be caused by round-off error in the sampled projection data or by various other factors inherent in data acquisition processes. However, several filtering techniques can be implemented to suppress the effects of noise. Therefore, a second problem of interest is to study the effectiveness of different filtering techniques in noise suppression.

48064 (UCRL-CR–104658) **Report on Radon Transform IC [integrated circuit].** Agi, I. Lawrence Livermore National Lab., CA (USA). 22 Nov 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016862. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goal of this project is to build an integrated circuit to calculate the Radon Transform and the backprojection operation at a 10 MHz video input rate. In completing this goal there are two different issues to be addressed. One is the analysis of the implementation of the Radon Transform in hardware and the second is the design and layout of the chip itself. The first issue involves studying different implementation algorithms and determining which algorithm is best suited for implementation on a chip. Because of its ease of implementation and small data size as compared with the exact transformations, the Radon Transform using interpolation was chosen. Interpolation in the forward transform requires interpolation in the backprojection operation as part of the calculation of the Inverse Radon Transform. Three interpolation schemes were considered for the forward transform and two schemes were considered for the backprojection. Of all these choices, the line length interpolation of the pixels in the forward transform along with linear interpolation of the values on the discrete s-axis resulted in the lowest mean squared error for high resolution reconstruction. However, line length interpolation needs four multiplications every clock period while linear interpolation needs only one. Software simulations showed no significant visual difference in the test images between the complicated line length interpolation and the linear interpolation for most applications of interest. As a result, linear interpolation was chosen in both the forward transform as well as the backprojection to reduce the chip area.

48065 (UCRL-CR–104659) **Radon Transform Coprocessor board description.** Shieh, E. Lawrence Livermore National Lab., CA (USA). 6 Nov 1989. 66p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90016863. Source: NTIS, PC A04/MF A01 - OSTI.

The design of the Radon Transform Coprocessor is derived from a parallel/pipeline architecture as proposed by Sanz et al. This architecture is well suited for fast reconstruction of images from projection data. This paper presents a high level block diagram of the coprocessor. The general operation and data flow is as follows. The host first puts the DSP chips in a hold state so that is may access the RAM. The host computer then downloads projection data into the dual ported RAM on the coprocessor and releases and resets the DSPs. Upon the reset, the DSPs begin computing the backprojection. Each DSP calculates a portion of each pixel in parallel with the other DSPs. Once this calculation is complete, the partial pixel value is passed down the pipeline to the next DSP which adds its contribution to the pixel. Once a DSP passes its contribution of the pixel down the pipeline, it then begins reconstructing the subsequent pixels of the image in raster scan fashion. The backprojected image is placed one pixel at a time on the host bus. For maximum speed, ideally there would be one processor per projection. Show is an open architecture with N processors, but for the prototype coprocessor, four DSPs will be used. The design accommodates a maximum of eight processors in the pipeline and can be easily modified to allow more than eight processors in the system. For the forward projection, the host sends pixel values down the pipeline and projection data is computed by each DSP in parallel. Once the DSPs are finished computing and are put in the hold state, the host may access the data for further processing.

48066 (UCRL-CR–104777) **New techniques in the deconvolution of a system function from measured data.** Soderstrand, M.A. (California Univ., Davis, CA (USA)); Quinlan, M.M. Lawrence Livermore National Lab., CA (USA); California Univ., Davis, CA (USA). [1990]. 42p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90015907. Source: NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this study is to develop a procedure and a set of computer algorithms which may be used to accurately characterize a 5Ghz Very High Bandwidth (VHB) system used by Lawrence Livermore National Laboratories in making measurements at the Nevada test Site. A former UC, Davis graduate student, Greg Berchin, developed a new Frequency Domain Identification (FDI) algorithm for identifying the modeling parameters for a microwave instrumentation system. This work investigates methods for applying this and other algorithms to the task of deconvolving the effect of the measuring system out of the measured data in order to obtain accurate measurements of the systems under test.

48067 New reduced dimensionality rate constants for D + H_2(v = 0,1) and H + D_2(v = 0,1) and a test of CEQB/G theory. Sun, Qiyan (Emory Univ., Atlanta, GA (USA)); Bowman, J.M. *Journal of Physical Chemistry (USA)*, 94(2): 718-721 (25 Jan 1990). DOE Contract FG05-86ER13568.

A new expression for the reduced dimensionality (CEQB) cumulative reaction probability is given after taking careful account of total angular momentum constraints. New CEQB rate constants are calculated from 200 to 2,000 K for the reactions D + H_2 and H + D_2 by using the ab initio LSTH potential, and for the reactions with H_2(v = 1) and D_2(v = 1) from 200 to 600 K. A comparison with rate constants calculated by using the more approximate CEQB/G theory is made. Very good agreement is found between the CEQB and CEQB/G thermal rate constants. However, for the vibrationally excited reactions, some differences are found, especially at and below room temperature due to subtle vibrationally nonadiabatic effects in the tunneling region. These are analyzed by using a simple vibrationally adiabatic model.

48068 Computer simulation of molecular collisions with a polymer surface. Gelb, A. (Physical Sciences Inc., Andover, MA (USA)); Sumpter, B.G.; Noid, D.W. *Journal of Physical Chemistry (USA)*, 94(2): 809-814 (25 Jan 1990). DOE Contract AC05-84OR21400.

Molecular dynamics is used to study a nonreactive collisional process of a nitrogen molecule with a polyethylene (PE) crystal surface. The collisional dynamics are examined for various impact velocities. The results indicate that there is a high efficiency of collisional energy and momentum transfer (molecule to surface). The intramolecular dynamics of the PE crystal show that the propagation of energy absorbed from a collision down a PE chain occurs on a picosecond time scale and that the energy is rapidly redistributed.

9903 Information Handling

Refer also to citation(s) 46652, 46825, 46968, 46973, 47374, 47479, 48055, 48056, 48057

48069 (CNIC–00300) **Abstracts China nuclear science and technology reports (1988).** China Nuclear Information Centre, Beijing, BJ (China). Mar 1989. 93p. (In Chinese). Order Number DE90638685. Source: NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The bibliographies and abstracts of China Nuclear Science and Technology Reports published in 1988 (Report Numbers CNIC -00115 ≈ CNIC-00254) are presented. The items are arranged according to INIS subject categories, which mainly are physics, chemistry, materials, earth sciences, life sciences, isotopes, isotope and radiation applications, engineering and technology, and other aspects of nuclear energy. The numbers on the left corners of the entries are report numbers, and on the right corners the serial numbers. A report number index is annexed.

48070 (ETDE/PUB–1-R1) **International Energy Subject Categories and Scope: Revision 1.** Grissom, M.C.; Kane, L. (eds.). Energy Technology Data Exchange, Oak Ridge, TN (USA). 1990. 59p. Sponsored by Energy Technology Data Exchange. Order Number DE90015197. Source: NTIS, PC A04/MF A01 - OSTI.

The purpose of this population is twofold: (1) to support organizations or individuals who select informational materials for inclusions in the ETDE (Energy Technology Data Exchange) and

(2) for use as an aid in database searching. Subject categories and corresponding codes are established to define the scope of, or degree of interest in, energy information to be selected by those who enter machine-readable bibliographic records into the Energy Data Base. For persons conducting online searching or creating selective dissemination of information (SDI) subsets, this publication facilitates the selection of energy topics. These scope notes and category definitions also apply to online energy databases identified as ENERGY on STN International (Federal Republic of Germany) and as DOE ENERGY offered by Dialog Information Services (USA). This publication is the first revision and contains no changes from International Energy: Subject Categories and Scope (ETDE/PUB-1) with the exception that title page and contents pages have been added.

Corporate Author Index

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52234	15:46886	*See* NUREG/CR–5567			
52236	15:46872	*See* NUREG/CR–5572			
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CONF-8611312–		(Seminar on oil pollution questions; Norrkoeping (Sweden); 19-20 Nov 1986)			
	15:46588	*See* BSE-PROC–22			
CONF-8703173–		(2. national colloquium on silicon; Paris (France); 9-11 Mar 1987)			
	15:46768	*See* AFME–87-11-0028			
CONF-8710518–		(Pyrolysis as a basic technology for large agro-energy projects workshop; L'Aquila (Italy); 15-16 Oct 1987)			
	15:46744	*See* EUR–11382			
CONF-880207–		(Discussion meeting on high-T_c superconductors; Mauterndorf (Austria); 7-11 Feb 1988)			
8	15:47185	*See* IS-M–622			
CONF-8802161–		(Workshop on technical and physical parameters for quality assurance in medical diagnostic radiology: tolerances, limiting values and appropriate measuring methods; Brussels (Belgium); 23-25 Feb 1988)			
	15:47664	*See* BIR–18			
CONF-880812–		(Applied superconductivity conference; San Francisco, CA (USA); 21-25 Aug 1988)			
47	15:47187	*See* IS-M–626			

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CONF-8808142–		(16. international congress of genetics; Toronto (Canada); 20-27 Aug 1988)			
Absts.	15:47650	National Research Council of Canada, Ottawa, Canada K1A 0R6			ND-408
CONF-880969–		(International symposium on metal-hydrogen systems, fundamentals and applications; Stuttgart (Germany, F.R.); 4-9 Sep 1988)			
7	15:47186	*See* IS-M–624			
8	15:46735	*See* CEA-CONF–10120			
9	15:46734	*See* CEA-CONF–10119			
10	15:46737	*See* CEA-CONF–10125			
11	15:46736	*See* CEA-CONF–10124			
CONF-8810189–		(Commission of European Communities workshop on testing of high level waste forms under repository conditions; Cadarache (France); 17-21 Oct 1988)			
	15:46657	*See* EUR–12017			
CONF-881252–		(IAEA specialists' meeting; Winfrith (UK); 6-8 Dec 1988)			
	15:46871	*See* IWGFR–69			
CONF-890305–		(7. international coal testing conference; Charleston, WV (USA); 21-23 Mar 1989)			
1	15:46349	*See* IS-M–621			
CONF-8903165–		(Reactor physics calculations in the Nordic countries; Oslo (Norway); 9-10 Mar 1989)			
	15:47458	*See* BHR–51			
CONF-890401–		(197. national meeting of the American Chemical Society; Dallas, TX (USA); 9-14 Apr 1989)			
	15:46642	*See* CEA-CONF–9973			
CONF-890402–		(10. international conference on fluidized-bed combustion; San Francisco, CA (USA); 30 Apr - 3 may 1989)			
10	15:46399	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015981	MF-103
CONF-890425–		(American power conference; Chicago, IL (USA); 24-26 Apr 1989)			
	15:46716				
	15:46873				
CONF-8904366–		(MELECON '89: 5th Mediterranean electrotechnical conference; Lisbon (Portugal); 11-13 Apr 1989)			
1	15:46800	*See* STEV-VIND–90-27			
2	15:46802	*See* STEV-VIND–90-29			
CONF-8905144–		(Tau-Charm Factory workshop; Stanford, CA (USA); 23-27 May 1989)			
18	15:47815	*See* UIUC-HEPG–90-65			
CONF-8905187–		(WEIN '89: international symposium on weak and electromagnetic interactions in nuclei; Montreal (Canada); 15-19 May 1989)			
10	15:47885	*See* PNL-SA–18052			
CONF-890525–		(International conference on global and regional environmental atmospheric chemistry; Beijing (China); 3-10 May 1989)			
	15:47500	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016693	PC-402
CONF-8905343–		(Workshop on winde/diesel systems; Goeteborg (Sweden); 8-9 May 1989)			
1	15:46796	*See* STEV-VIND–90-20			
CONF-890615–		(Building simulation '89; Vancouver (Canada); 23-24 Jun 1989)			
3	15:46968	*See* LBL–28274			
CONF-890701–		(International cryogenic materials conference; Los Angeles, CA (USA); 24-28 Jul 1989)			
29	15:48022	*See* UCRL–101604			
CONF-890717–		(EWEC '89: European wind energy conference and exhibition; Glasgow (UK); 10-13 Jul 1989)			
5	15:46798	*See* STEV-VIND–90-22			
6	15:46801	*See* STEV-VIND–90-28			
7	15:46806	*See* STEV-VIND–90-34			

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CONF-8907205–		(Conference on computational techniques and applications; Brisbane (Australia); 10-12 Jul 1989)			
	15:47960	*See* ANU-PRL-TP–89/13			
CONF-8909204–		(4. international conference on hydrogen effects on material behavior; Jackson Hole, WY (USA); 12-16 Sep 1989)			
6	15:46738	*See* KCP–613-4204			
CONF-8909248–		(6. international RETRAN meeting; Washington, DC (USA); 17-20 Sep 1989)			
	15:46878	*See* EPRI-NP–6949			
CONF-8909249–		(Lattice '89: symposium on lattice field theory; Capri (Italy); 18-21 Sep 1989)			
14	15:47804	*See* DOE/ER/05490–110			
CONF-8909262–		(International symposium on muon catalyzed fusion μCF - 89; Oxford (UK); 10-13 Sep 1989)			
	15:47959	*See* RAL–90-022			
CONF-8909291–		(8. topical workshop on proton-antiproton collider physics; Castiglione della Pescaia (Italy); 1-5 Sep 1989)			
11	15:47869	*See* FNAL/C–89/261-E			
CONF-8909361–		(Course on advanced accelerator physics; Uppsala (Sweden); 18-29 Sep 1989)			
	15:47406	*See* CERN–90-04			
CONF-890981–		(Windpower '89; San Francisco, CA (USA); 24-27 Sep 1989)			
5	15:46799	*See* STEV-VIND–90-23			
CONF-891004–		(4. international topical meeting on nuclear reactor thermal hydraulics; Karlsruhe (Germany, F.R.); 10-13 Oct 1989)			
	15:46848	*See* DNE-R–10			
CONF-8910199–		(European symposium on elastic-plastic fracture mechanics; Freiburg (Germany, F.R.); 9-12 Oct 1989)			
	15:46861	*See* ESTD-L–0111/R89			
CONF-891044–		(1. international conference on radioactive nuclear beams; Berkeley, CA (USA); 16-18 Oct 1989)			
12	15:47407	*See* LBL–28470			
CONF-8910444–		(International symposium Ahrenshoop; Ahrenshoop (German Democratic Republic); 9-13 Oct 1989)			
	15:47862	*See* NORDITA–90/2-P(prepr.)			
CONF-891052–		(7. American Physical Society topical conference on atomic processes in plasmas; Gaithersburg, MD (USA); 2-5 Oct 1989)			
	15:47777	American Institute of Physics, 335 E. 45th Street, New York, NY 10017			MF-420
CONF-891119–		(Materials Research Society fall meeting; Boston, MA (USA); 27 Nov - 2 dec 1989)			
136	15:47219	*See* SAND–89-2771C			
137	15:47251	*See* PNL-SA–17225			
138	15:47789	*See* PNL-SA–17230			
139	15:47252	*See* PNL-SA–18059			
CONF-9001110–		(13. Nordic meeting on structural chemistry; Copenhagen (Denmark); 8 Jan 1990)			
	15:47191	*See* KU-HCOE-FL2-R–90-8			
CONF-900171–		(1. international symposium on microbiology of the deep subsurface; Orlando, FL (USA); 15-18 Jan 1990)			
3	15:47686	*See* PNL-SA–17695			
CONF-900183–		(Recontres De Moriond '90: new and exotic phenomena; Les Arcs (France); 20-27 Jan 1990)			
	15:47781	*See* GSI–90-29(prepr.)			
CONF-900193–		(Division of particle; Houston, TX (USA); 2 Jan 1990)			
6	15:47813	*See* UIUC-HEPG–90-58			
CONF-900206–		(119. TMS (The Minerals, Metals & Metallurgical Society) annual meeting and exhibit; Anaheim, CA (USA); 18-22 Feb 1990)			
11	15:47126	*See* CEA-CONF–10132			

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CONF-9002109–		(Specialists' meeting on measurement, calculation and evaluation of photon production cross sections; Smolenice (Czechoslovakia); 5-7 Feb 1990)			
	15:47901	*See* INDC(NDS)–233			
CONF-9002128–		(Workshop on beam dynamics issues of high luminosity asymmetric collider rings; Berkeley, CA (USA); 12-16 Feb 1990)			
2	15:47408	*See* SLAC-PUB–5299			
CONF-9002140–		(Chaos down under; Sydney (Australia); Feb 1990)			
1	15:47954	*See* LA-UR–90-2660			
CONF-9002141–		(Technical steering panel meeting; Richland, WA (USA); 15-16 Feb 1990)			
1	15:47689	*See* PNL-SA–17918-HEDR			
CONF-900331–		(Workshop on heavy ion physics at the alternating gradient synchrotron; Upton, NY (USA); 3-7 Mar 1990)			
14	15:47802	*See* BNL–44931			
CONF-900402–		(199. national meeting of the American Ceramic Society; Boston, MA (USA); 22-27 Apr 1990)			
9	15:47539	*See* PNL-SA–17429			
10	15:46375	*See* PNL-SA–17750			
CONF-900406–		(1. international topical meeting on high-level radioactive waste management; Las Vegas, NV (USA); 8-12 Apr 1990)			
73	15:46671	*See* PNL-SA–17379			
CONF-9004112–		(Workshop on hadron structure functions and parton distributions; Batavia, IL (USA); 26-28 Apr 1990)			
4	15:47807	*See* FNAL/C–90/155			
CONF-9004133–		(American power conference; Chicago, IL (USA); 23-25 Apr 1990)			
4	15:46818	*See* PNL-SA–17992			
CONF-9004220–		(International workshop on nuclear dynamics; Elba (Italy); 2-7 Apr 1990)			
	15:47894	*See* GSI–90-30(prepr.)			
CONF-9004223–		(1. international conference on systems integration; Morristown, NJ (USA); 23-26 Apr 1990)			
1	15:47478	*See* PNL-SA–17205			
CONF-9004230–		(Workshop on non-linear problems in future particle accelerators; Capri (Italy); 19-25 Apr 1990)			
2	15:47416	*See* SLAC-PUB–5304			
CONF-9004239–		(41. Mosbach colloquium; Heidelberg (Germany, F.R.); 4-6 Apr 1990)			
1	15:47624	*See* LA-UR–90-2733			
CONF-9004240–		(Workshop on massively parallel computing in magnetic fusion energy; Williamsburg, VA (USA); 25-26 Apr 1990)			
Summs.	15:48024	*See* UCRL-JC–104774			
CONF-900442–		(Engineering, construction and operations for space; Albuquerque, NM (USA); Apr 1990)			
4	15:46852	*See* PNL-SA–17201			
CONF-900450–		(Nuclear structure in the '90's; Oak Ridge, TN (USA); 23-27 Apr 1990)			
10	15:47439	NTIS, PC A03/MF A01; GPO Dep.	E 1.99:	DE90016849	MF-413
CONF-900466–		(Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990)			
82	15:47172	*See* PNL-SA–17825			
CONF-900476–		(IAH conference on subsurface contamination by immiscible fluids; Calgary (Canada); 18-20 Apr 1990)			
2	15:47616	*See* PNL-SA–18118			
CONF-900495–		(Annual meeting of the Division of Physics of Beams of the American Physical Society; Washington, DC (USA); 16-19 Apr 1990)			
2	15:47733	*See* PNL-SA–17819			

CONF-9005161–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9005161–		(14. Gatlinburg actinide separations conference; Gatlinburg, TN (USA); 14-17 May 1990)			
	15:46643	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016541	MF-401
CONF-9005162–		(TIMS/ORSA joint national meeting; Las Vegas, NV (USA); 7-9 May 1990)			
2	15:47479	*See* PNL-SA–18088			
CONF-9005178–		(2. annual international seminar on radioactive waste products; Julich (Germany, F.R.); 28 May - 1 jun 1990)			
2	15:46672	*See* PNL-SA–17847			
CONF-9005183–		(8. symposium on energy engineering sciences: micro/macro studies of multiphase media; Argonne, IL (USA); 9-11 May 1990)			
	15:47379	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014844	MF-400
CONF-9005194–		(2. neutral particle beam technical symposium; San Diego, CA (USA); 20-24 May 1990)			
2	15:47428	*See* UCRL-JC–104776			
CONF-9005237–		(10. annual conference on nonlinear science: the next decade; Los Alamos, NM (USA); 21-25 May 1990)			
4	15:47799	*See* LA-UR–90-2744			
5	15:47798	*See* LA-UR–90-2743			
6	15:47955	*See* LA-UR–90-2714			
CONF-9005248–		(Evolution in astrophysics: IUE astronomy in the era of new space missions; Toulouse (France); 29 May - 1 jun 1990)			
2	15:47751	*See* LA-UR–90-2389			
CONF-9005261–		(North American conference on forestry responses to climate change; Washington, DC (USA); 15-17 May 1990)			
1	15:47501	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016526	MF-242
CONF-9005264–		(DESY topical meeting: small-x behavior of deep inelastic structure functions in QCD; Hamburg (Germany, F.R.); 14-16 May 1990)			
1	15:47834	*See* SLAC-PUB–5313			
2	15:47833	*See* SLAC-PUB–5312			
CONF-900542–		(21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference; Kissimmee, FL (USA); 21-25 May 1990)			
Exc.	15:46776	*See* SERI/TP–210-3833			
CONF-900546–		(4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990)			
13	15:46958	*See* PNL-SA–18162			
CONF-900570–		(8. international conference on ultrarelativistic nucleus-nucleus collisions: Quark Matter '90; Menton (France); 7-11 May 1990)			
9	15:47871	*See* LA-UR–90-2717			
10	15:47883	*See* BNL–44968			
CONF-900601–		(12. international conference on particles and nuclei; Cambridge, MA (USA); 24-29 Jun 1990)			
6	15:47876	*See* LA-UR–90-2737			
7	15:47810	*See* LA-UR–90-2690			
CONF-900603–		(2. European particle accelerator conference; Nice (France); 11-16 Jun 1990)			
33	15:47422	*See* LA-UR–90-2667			
CONF-900607–		(Advances in human factors research on man-computer interactions: nuclear and beyond; Nashville, TN (USA); 10-15 Jun 1990)			
5	15:46868	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016021	MF-520
CONF-9006111–		(Conference on mesoscale processes and mountain meteorology; Boulder, CO (USA); 25-29 Jun 1990)			
4	15:47541	*See* PNL-SA–17987			
6	15:47540	*See* PNL-SA–17536			
7	15:47542	*See* PNL-SA–17988			
8	15:47556	*See* PNL-SA–18054			
CONF-900619–		(5. AIAA/ASME thermal physics and heat transfer conference; Seattle, WA (USA); 18-20 Jun 1990)			
7	15:47382	*See* PNL-SA–17526			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9006199–		(United States delegation to the Soviet Union on environmental restoration and waste management conference; Moscow (USSR); 15-29 Jun 1990)			
2	15:46684	*See* WHC-SA–0937			
CONF-9006212–		(International symposium on nuclear astrophysics: nuclei in the cosmos; Vienna (Austria); 18-22 Jun 1990)			
2	15:47755	*See* LA-UR–90-2909			
CONF-900623–		(15. symposium on effects of radiation on materials; Nashville, TN (USA); 17-21 Jun 1990)			
16	15:47171	*See* PNL-SA–17621			
CONF-9006241–		(38. ASMS conference on mass spectrometry and allied topics; Tucson, AZ (USA); 4-8 Jun 1990)			
5	15:47471	*See* PNL-SA–17711			
CONF-9006245–		(Rexx symposium for developers and users; Stanford, CA (USA); 11 Jun 1990)			
	15:48060	*See* SLAC–368			
CONF-900626–		(2. international conference on advanced technology and particle physics; Como (Italy); 11-15 Jun 1990)			
1	15:47451	*See* SLAC-PUB–5305			
CONF-9006261–		(Mechanisms of chromospheric and coronal heating; Heidelberg (Germany, F.R.); 5-8 Jun 1990)			
1	15:47752	*See* LA-UR–90-2764			
CONF-9006262–		(American association for the advancement of science symposium agricultural water conservation and quality; Davis, CA (USA); 19-23 Jun 1990)			
1	15:47617	*See* PNL-SA–18352			
CONF-9006264–		(65. international western annual economic association conference; San Diego, CA (USA); 29 Jun - 3 jul 1990)			
1	15:46887	*See* PNL-SA–18160			
CONF-9006265–		(Optical fabrication and testing workshop; Monterey, CA (USA); 12-14 Jun 1990)			
1	15:47255	*See* UCRL–102807			
CONF-9006267–		(1990 DPF summer study on high energy physics; Snowmass, CO (USA); 25 Jun - 13 jul 1990)			
1	15:47806	*See* FNAL/C–90/151			
2	15:47853	*See* DOE/ER/05490–111			
CONF-9006268–		(10. international conference on physics in collision; Durham, NC (USA); 21-23 Jun 1990)			
1	15:47808	*See* FNAL/C–90/160-E			
CONF-900632–		(Meeting of the International Materials Research Society; Beijing (China); 18-22 Jun 1990)			
1	15:47128	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017319	MF-404
CONF-900676–		(83. annual meeting and exhibition of the Air and Waste Management Association; Pittsburgh, PA (USA); 24-29 Jun 1990)			
13	15:46721	*See* PNL-SA–18138			
CONF-900679–		(1990 Health Physics Society meeting; Anaheim, CA (USA); 24-28 Jun 1990)			
7	15:47734	*See* PNL-SA–18314			
8	15:47705	*See* PNL-SA–17741			
CONF-9007106–		(Institute of nuclear materials management conference; Los Angeles, CA (USA); 15-18 Jul 1990)			
54	15:46640	*See* WHC-SA–0658			
59	15:46725	*See* PNL-SA–18037			
60	15:46723	*See* BNL–44962			
62	15:46727	*See* UCRL-JC–104488			
63	15:46726	*See* UCRL-JC–104453			
64	15:46673	*See* PNL-SA–18411			
65	15:46674	*See* PNL-SA–18413			
66	15:46648	*See* PNL-SA–18412			
68	15:46722	*See* WHC-SA–0875			
69	15:46728	*See* WHC-SA–0853			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9007109–		(Rocky Mountain analytical conference; Denver, CO (USA); 30 Jul 1990)			
2	15:47389	*See* WHC-SA–0872			
CONF-9007136–		(1990 summer workshop on nonlinear and chaotic phenomena in plasmas, solids, and fluids; Edmonton (Canada); 16-27 Jul 1990)			
3	15:47956	*See* LA-UR–90-2755			
CONF-9007157–		(SPIE conference on EUV x-ray and gamma-ray instrumentation for astronomy; San Diego, CA (USA); 8-13 Jul 1990)			
1	15:47753	*See* LA-UR–90-2851			
CONF-9007158–		(Armagh international colloquium: surface inhomogenities; Armagh (Ireland); 24-27 Jul 1990)			
1	15:47754	*See* LA-UR–90-2903			
CONF-9007160–		(8. international conference on methods in protein sequence analysis; Kiruna (Sweden); 1-7 Jul 1990)			
1	15:47623	*See* BNL–43799			
CONF-9007161–		(BETECH '90; Newark, DE (USA); 10-12 Jul 1990)			
1	15:47343	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017023	MF-405
CONF-9007164–		(International systems science society neural networks symposium; Portland, OR (USA); 8-13 Jul 1990)			
1	15:48053	*See* PNL-SA–18409			
CONF-9007165–		(American statistical association (ASA) conference on radiation and health; Copper Mountain, CO (USA); 8-13 Jul 1990)			
1	15:47706	*See* PNL-SA–18380			
2	15:47707	*See* PNL-SA–18391			
CONF-9007168–		(1990 workshop on dynamical symmetry breaking; 25. IUPAP international conference on high energy physics; Nagoya (Japan); Singapore (Singapore); 24-27 Jul 1990; 2-8 aug 1990)			
1	15:47849	*See* FNAL/C–90/170-T			
CONF-900733–		(3. international workshop on respiratory tract dosimetry; Albuquerque, NM (USA); 1-3 Jul 1990)			
1	15:47704	*See* PNL-SA–17594			
2	15:46720	*See* PNL-SA–17757			
CONF-900736–		(Conference on nondestructive evaluation of modern ceramics; Columbus, OH (USA); 9-12 Jul 1990)			
3	15:47218	*See* PNL-SA–18383			
CONF-900751–		(6. international conference on valence fluctuations; Rio de Janeiro (Brazil); 9-13 Jul 1990)			
3	15:47943	*See* LA-UR–90-2623			
CONF-900756–		(SPIE's international symposium on optical and optoelectronic applied science and engineering exhibit; San Diego, CA (USA); 8-13 Jul 1990)			
37	15:47463	*See* UCRL-JC–104336			
38	15:47473	*See* UCRL–102583			
39	15:47419	*See* BNL–44959			
CONF-900772–		(4. workshop on experiments and detectors for a relativistic heavy ion collider; Upton, NY (USA); 2-7 Jul 1990)			
2	15:47888	*See* BNL–45003			
3	15:47866	*See* BNL–44992			
4	15:47434	*See* BNL–44967			
CONF-900792–		(15. international pyrotechnics seminar; Boulder, CO (USA); 9-13 Jul 1990)			
10	15:47483	*See* MLM–3652(OP)			
CONF-900793–		(AAAI '90: 8. national conference on artificial intelligence; Boston, MA (USA); 17 Jul - 3 aug 1990)			
4	15:48052	*See* PNL-SA–18090			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900802–		(200. American Chemical Society national meeting; Washington, DC (USA); 26-31 Aug 1990)			
5	15:47193	*See* LA-UR–90-2792			
CONF-900809–		(21. DOE/NRC nuclear air cleaning conference; San Diego, CA (USA); 13-16 Aug 1990)			
2	15:47375	*See* UCRL-JC–104586			
3	15:47505	*See* LA-UR–90-2735			
CONF-9008125–		(Explomet conference; San Diego, CA (USA); 12-17 Aug 1990)			
4	15:47311	*See* SAND–90-0647C			
5	15:47192	*See* LA-UR–90-2699			
6	15:47133	*See* LA-UR–90-2677			
7	15:47134	*See* LA-UR–90-2678			
8	15:47135	*See* LA-UR–90-2679			
CONF-9008134–		(1990 national conference of standards laboratories (NCSL) symposium and workshop; Washington, DC (USA); 19-23 Aug 1990)			
1	15:47461	*See* SAND–89-2878C			
2	15:47460	*See* SAND–89-2877C			
CONF-9008138–		(8. international biodeterioration and biodegradation symposium; Windsor (Canada); 26-31 Aug 1990)			
1	15:46658	*See* FMPC–2209			
CONF-9008139–		(5. international symposium on solar high-temperature technologies; Davos (Switzerland); 27-31 Aug 1990)			
1	15:47069	*See* SAND–90-0935C			
CONF-900814–		(7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990)			
10	15:47880	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016528	MF-413
11	15:46860	NTIS, PC A03/MF A01; OSTI; INIS		DE90016856	
12	15:46825	NTIS, PC A03/MF A01; OSTI; INIS		DE90017016	
CONF-9008141–		(6. international conference on XAFS meeting; York (UK); 5-11 Aug 1990)			
1	15:47125	*See* BNL–44434			
2	15:47944	*See* LA-UR–90-2633			
CONF-9008142–		(Laser applications in life science; Moscow (USSR); 17-31 Aug 1990)			
1	15:47682	*See* LA-UR–90-2854			
CONF-9008143–		(Superlattices and microstructures; Berlin (Germany, F.R.); 13-16 Aug 1990)			
1	15:47933	*See* LA-UR–90-2632			
CONF-9008148–		(SHARE 75; New Orleans, LA (USA); 12-17 Aug 1990)			
1	15:47427	*See* SLAC-PUB–5292			
CONF-900818–		(International conference on shock wave and high-strain-rate phenomena in materials; San Diego, CA (USA); 12-17 Aug 1990)			
3	15:47173	*See* UCRL-JC–103469			
4	15:47137	*See* LA-UR–90-2801			
5	15:47485	*See* UCRL-JC–103654			
CONF-900822–		(25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990)			
7	15:47803	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017405	MF-414
8	15:47849	*See* FNAL/C–90/170-T			
CONF-900828–		(Summer national meeting of the American Institute of Chemical Engineers; San Diego, CA (USA); 19-22 Aug 1990)			
7	15:46494	*See* LA-UR–90-2774			
CONF-900830–		(5. international conference on solid films and surfaces; Providence, RI (USA); 13-17 Aug 1990)			
1	15:47129	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016527	MF-404
CONF-900833–		(ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990)			
7	15:46965	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016524	MF-350

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900853–		(Gasification and gas stream cleanup systems; Morgantown, WV (USA); 28-30 Aug 1990)			
3	15:46350	*See* BNL–44981			
CONF-900870–		(10. international symposium on boron, borides and related compounds; Albuquerque, NM (USA); 27-30 Aug 1990)			
3	15:47195	*See* LA-UR–90-2847			
4	15:47283	*See* SAND–90-2060C			
CONF-9009123–		(Linear accelerator conference; Albuquerque, NM (USA); 9-14 Sep 1990)			
1	15:47426	*See* SAND–90-2287C			
CONF-9009153–		(17. annual conference of the American Society for Quality Control; Tucson, AZ (USA); 9-12 Sep 1990)			
2	15:46685	*See* WHC-SA–0982			
CONF-9009166–		(12. international free electron laser conference (FEL-12); Paris (France); 17-21 Sep 1990)			
1	15:47412	*See* LA-UR–90-2845			
2	15:47411	*See* LA-UR–90-2809			
CONF-900918–		(16. symposium on fusion technology; London (UK); 3-7 Sep 1990)			
1	15:48020	*See* SAND–90-2018C			
2	15:48023	*See* UCRL-JC–103337			
3	15:47996	*See* LA-UR–90-2887			
4	15:47987	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017024	MF-420
5	15:47988	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016875	MF-420
CONF-9009192–		(International symposium on discharges and electrical insulation in vacuum; Santa Fe, NM (USA); 17-20 Sep 1990)			
13	15:48017	*See* SAND–90-1003C			
CONF-9009200–		(1990 LINAC conference; Albuquerque, NM (USA); 10-14 Sep 1990)			
4	15:47414	*See* LA-UR–90-2919			
5	15:47413	*See* LA-UR–90-2888			
6	15:47410	*See* LA-UR–90-2759			
7	15:47423	*See* LA-UR–90-2740			
8	15:47409	*See* LA-UR–90-2739			
10	15:48019	*See* SAND–90-1491C			
CONF-9009221–		(6. international symposium on gaseous dielectrics; Knoxville, TN (USA); 23-27 Sep 1990)			
3	15:47778	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016873	MF-411
CONF-9009226–		(Committee on safety of nuclear installations (CSNI); Santa Fe, NM (USA); 4-6 Sep 1990)			
2	15:46890	*See* SAND–90-2313C			
CONF-9009235–		(x-ray microscopy conference; London (UK); 3-7 Sep 1990)			
1	15:47462	*See* LA-UR–90-2915			
CONF-9009240–		(National academy of sciences committee on atmospheric change; Washington, DC (USA); 25-26 Sep 1990)			
1	15:47543	*See* UCRL-JC–104734			
CONF-901004–		(Conference on magnetism and magnetic materials; San Diego, CA (USA); 30 Oct - 2 nov 1990)			
1	15:47194	*See* LA-UR–90-2799			
2	15:47946	*See* LA-UR–90-2708			
3	15:47136	*See* LA-UR–90-2688			
4	15:47945	*See* LA-UR–90-2671			
CONF-9010171–		(Workshop on design and assurance for software safety; Las Cruces, NM (USA); 16-18 Oct 1990)			
2	15:48058	*See* SAND–90-2255C			
CONF-9010172–		(61. shock and vibration symposium; Pasadena, CA (USA); 16-18 Oct 1990)			
1	15:47387	*See* SAND–90-1583C			
2	15:47491	*See* UCRL-JC–104541			
CONF-9010174–		(Enhancing electricity's value to society; Toronto (Canada); 22-24 Oct 1990)			
1	15:46934	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015798	MF-350

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9010186–		(HAZTECH international 1990 conference; Pittsburgh, PA (USA); 2 Oct 1990)			
1	15:47571	*See* LA-UR–90-2843			
2	15:46683	*See* WHC-SA–0880			
CONF-901025–		(13. international conference on plasma physics and controlled nuclear fusion research; Washington, DC (USA); 1-6 Oct 1990)			
4	15:47995	*See* LA-UR–90-2715			
5	15:47964	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017021	MF-420
CPD–					
5A	15:46756	*See* PB–90-215245/XAB			
CPS–					
90-010	15:47393	*See* AD-A–222085/3/XAB			
CRIE-U–					
89040	15:47738	NTIS (US Sales Only), PC A03/MF A01		DE90517064	
CRIE-W–					
89011	15:46952	NTIS (US Sales Only), PC A03/MF A01		DE90517069	
89021	15:46953	NTIS (US Sales Only), PC A04/MF A01		DE90517068	
89026	15:46351	NTIS (US Sales Only), PC A03/MF A01		DE90517067	
CRIE-Y–					
89005	15:46898	NTIS (US Sales Only), PC A03/MF A01		DE90517065	
89006	15:46893	NTIS (US Sales Only), PC A03/MF A01		DE90517066	
CRREL-SR–					
90-7	15:47561	*See* AD-A–222447/5/XAB			
CTH-IEFT-PP–					
1989-19	15:47965	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638958	
1989-20	15:47966	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638976	
1990-05	15:47967	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638977	
1990-06	15:47792	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90638956	
CTH-R–					
89-8	15:46796	*See* STEV-VIND–90-20			
89-11	15:46802	*See* STEV-VIND–90-29			
89-12	15:46801	*See* STEV-VIND–90-28			
89-14	15:46800	*See* STEV-VIND–90-27			
89-16	15:46798	*See* STEV-VIND–90-22			
89-18	15:46806	*See* STEV-VIND–90-34			
89-19	15:46799	*See* STEV-VIND–90-23			
CTH-RF–					
72	15:47440	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90640057	
CTP–					
1763	15:47860	*See* NORDITA–89/29-P(prepr.)			
DNE-R–					
10	15:46848	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638485	
DOE/AL/58309–					
46	15:46647	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017272	MF-721
DOE/BC/14434–					
1	15:46484	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016733	MF-122
DOE/BC/14473–					
3	15:46485	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016736	MF-122
DOE/BC/14659–					
1	15:46492	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016735	MF-122
DOE/BC/14666–					
1	15:46486	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016734	MF-122
DOE/BP–					
1307	15:47549	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017093	MF-903
DOE/CE–					
0293P	15:46928	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014849	PC-350
0294P	15:46917	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014838	MF-350
DOE/CE/15401–					
T8	15:47467	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014080	MF-310
DOE/CE/26559–					
T4	15:47073	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016300	MF-350
DOE/CE/26577–					
T4	15:47074	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015520	MF-350

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DOE/CH/10381–					
7	15:46613	The National Consumer Law Center, 236 Massachusetts Avenue, N.E., Washington, D.C. 20002			ND-121
DOE/EH–					
0158T	15:47693	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016673	MF-607
0159T	15:46718	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016697	PC-610
DOE/EIA–					
0035(90/05)	15:46942	NTIS, PC A07/MF A01 - GPO; OSTI; INIS; GPO Dep.	E 1.99:	DE90015988	MF-950
0109(90/06)	15:46582	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90017411	MF-950
0121(90/1Q)	15:46474	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90016799	MF-950
0125(90/1Q)	15:46475	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90017412	MF-950
0202(90/1Q)	15:46929	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90016013	MF-950
0455(88)	15:46935	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90015997	MF-950
0478(89)	15:46635	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90017413	MF-950
0520(90/08)	15:46583	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90016285	MF-950
M028(90)	15:46584	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015982	MF-950
DOE/ER/05096–					
41	15:47800	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017281	MF-414
DOE/ER/05490–					
110	15:47804	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017406	MF-414
111	15:47853	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017402	MF-414
123	15:47801	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017278	MF-414
DOE/ER/13406–					
5	15:47293	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017601	MF-401
DOE/ER/13600–					
T1	15:47468	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017103	MF-404; MF-406
T3	15:47469	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017220	MF-406
DOE/ER/13702–					
3	15:46616	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016605	MF-401
DOE/ER/13850–					
15	15:47233	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016306	MF-401
DOE/ER/13860–					
3	15:47368	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017223	MF-410
DOE/ER/13946–					
1	15:47274	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016731	MF-401
DOE/ER/14058–					
1	15:47739	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017329	MF-403
DOE/ER/40143–					
7	15:47805	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017279	MF-413
DOE/ER/40231–					
T9	15:47854	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017285	MF-414
DOE/ER/40256–					
5	15:47867	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016502	MF-414
DOE/ER/40310–					
T1	15:47441	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016496	MF-413
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2	15:47868	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016307	MF-401; MF-413
DOE/ER/45330–					
2	15:47234	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017287	MF-404; MF-406
DOE/ER/52122–					
5	15:47989	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017600	MF-421
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T5	15:47968	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017607	MF-420
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DOE/ER/53223–					
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DOE/ER/53291–					
1	15:47970	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017606	MF-427
DOE/ER/60434–					
5	15:47679	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017335	MF-408
DOE/ER/60633–					
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DOE/ER/60656–					
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DOE/ET/10815–140	15:46948	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016303	MF-112
DOE/ET/53068–436	15:47972	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017265	MF-420
443	15:47973	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017091	MF-422
444	15:47974	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017090	MF-427
445	15:47975	NTIS, PC A04/MF A01; OSTI; INIS		DE90017092	MF-426
446	15:47749	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017616	MF-420
56	15:47971	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016893	MF-420
DOE/FE–0198P	15:46819	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016669	PC-105
DOE/HWP–102	15:47059	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016542	MF-902
DOE/ID/12655–2	15:47130	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015283	PC-313
DOE/IG–0287	15:46910	OSTI (Free of Charge)		TI90016667	PC-960
DOE/LLW–74T-Rev.1	15:46652	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015996	MF-721
DOE/MC/22049–2797	15:46356	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000454	MF-109
DOE/MC/22063–2843	15:46357	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009655	MF-109
DOE/MC/24157–2845	15:46620	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009658	MF-132
DOE/METC–90/4100	15:46493	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009670	MF-122
DOE/NCT–04	15:46877	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015896	MF-610
DOE/NV/10845–3	15:47568	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017094	MF-702
DOE/OR/00033–T438	15:47990	NTIS, PC A10/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017504	MF-516
T443	15:47908	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017509	MF-505
DOE/PC/70808–T4	15:46358	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017219	MF-113
DOE/PC/79669–T2	15:46949	NTIS, PC A15/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008837	MF-112
DOE/PC/79921–T8	15:47184	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016764	MF-106
DOE/PC/88800–25	15:46359	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016753	MF-108
DOE/PC/88806–T4	15:46360	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016757	MF-108
DOE/PC/88827–T5	15:46581	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016801	MF-125
DOE/PC/88874–T9	15:46820	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016794	MF-105
DOE/PC/88878–T7	15:46336	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016765	MF-113
DOE/PC/88883–T6	15:46337	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016766	MF-102
DOE/PC/88913–T6	15:46469	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016760	MF-103
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DOE/PC/88922–7	15:46363	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016752	MF-102
DOE/PC/88926–T3	15:46377	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016761	MF-113
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DOE/PC/88934–T6	15:46379	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016797	MF-102
DOE/PC/88939–9	15:46380	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016793	MF-102
DOE/PC/88949–T7	15:46397	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016795	MF-114
DOE/PC/89904–T15	15:46364	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016756	MF-102

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T16	15:46338	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016798	MF-102; MF-113
DOE/PC/90005–					
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T21	15:46366	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016749	MF-108
T22	15:46367	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016562	MF-108
T27	15:46368	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016751	MF-108
DOE/PC/90909–					
T10	15:46369	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017249	MF-108
DOE/RL–					
87-15	15:46653	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017228	MF-510
90-35	15:46719	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017268	MF-511
90-36	15:47569	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016429	MF-702
DOE/S–					
0010(89)	15:46918	NTIS, PC A18/MF A01 - GPO; OSTI; INIS; GPO Dep.	E 1.99:	DE90016651	MF-900
0079	15:46919	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015878	MF-900
0080	15:46920	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015877	MF-900
DOE/SR/18049–					
2	15:47570	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017262	MF-702
DOE/WIPP–					
89-022	15:46654	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013695	MF-721
DSPHN–					
0002	15:47498	*See* CNIC–00301			
Dounreay-Trans–					
1030	15:46655	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640170	
E–					
710	15:47808	*See* FNAL/C–90/160-E			
ECAC-CIN–					
405	15:47715	*See* PB–90-215294/XAB			
ECN-C–					
90-021	15:46811	NTIS (US Sales Only), PC A03/MF A01		DE90519649	
90-023	15:46470	NTIS (US Sales Only), PC A03/MF A01		DE90519650	
90-024	15:46790	NTIS (US Sales Only), PC A08/MF A01		DE90519651	
90-027	15:46954	NTIS (US Sales Only), PC A03/MF A01		DE90519652	
90-030	15:47502	NTIS (US Sales Only), PC A03/MF A01		DE90519653	
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90-028	15:46779	NTIS (US Sales Only), PC A03/MF A01		DE90519654	
EEG–					
46	15:46647	*See* DOE/AL/58309–46			
EGG–					
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9120	15:47991	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015421	MF-700
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EPA–					
450/3-82/001B	15:47535	*See* PB–90-247495/XAB			
450/3-83/005B	15:47534	*See* PB–90-247487/XAB			
450/3-89/009	15:47537	*See* PB–90-252503/XAB			
530/SW-90/062D	15:47509	*See* PB–90-234717/XAB			
540/8-90/004	15:47536	*See* PB–90-249442/XAB			
600/D-90/049	15:47528	*See* PB–90-246323/XAB			
600/D-90/050	15:47530	*See* PB–90-246356/XAB			
600/D-90/051	15:47371	*See* PB–90-246349/XAB			
600/D-90/052	15:47529	*See* PB–90-246331/XAB			
600/D-90/053	15:47526	*See* PB–90-246257/XAB			
600/D-90/056	15:46753	*See* PB–90-246364/XAB			
600/D-90/070	15:47523	*See* PB–90-246216/XAB			
600/D-90/082	15:47599	*See* PB–90-246463/XAB			
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600/J-89/399	15:47724	*See* PB–90-245952/XAB			
600/J-89/400	15:47723	*See* PB–90-245945/XAB			
600/J-89/403	15:46479	*See* PB–90-245929/XAB			
600/J-89/408	15:47722	*See* PB–90-245879/XAB			
600/J-89/416	15:47720	*See* PB–90-245788/XAB			
600/J-89/425	15:47554	*See* PB–90-245721/XAB			
600/J-90/055	15:47515	*See* PB–90-245341/XAB			

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600/J-90/067	15:47517	*See* PB–90-245689/XAB			
600/J-90/068	15:47516	*See* PB–90-245671/XAB			
600/J-90/069	15:47513	*See* PB–90-245242/XAB			
600/J-90/080	15:47718	*See* PB–90-245465/XAB			
600/J-90/099	15:46610	*See* PB–90-245275/XAB			
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6943-Vol.1-Pt.1	15:46894	Research Reports Center, Box 50490, Palo Alto, CA 94303			
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0072/R89	15:47131	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639508	
0111/R89	15:46861	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639980	
ETDE/PUB–					
1-R1	15:48070	NTIS, PC A04/MF A01 - OSTI		DE90015197	
ETLA–					
316	15:46943	NTIS (US Sales Only), PC A04/MF A01		DE90518713	
ETSU-R–					
51	15:46946	NTIS (US Sales Only), PC A06/MF A01		DE90519536	
54	15:46911	NTIS (US Sales Only), PC A03/MF A01		DE90519511	
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4048-P3	15:46767	NTIS (US Sales Only), PC A03/MF A01		DE90519538	

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ETSU-TID–					
4067	15:46785	NTIS (US Sales Only), PC A05/MF A01		DE90519539	
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11382	15:46744	NTIS (US Sales Only), PC A10/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 17.50		TI90016059	
11620	15:47664	*See* BIR–18			
12017	15:46657	NTIS (US Sales Only), PC A; OSTI; Office for Official Publications of the European Communities 2, rue Mercier L-2985 Luxembourg; Price ECU 22.50		TI90015980	
12102	15:46750	NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI90016453	
12107	15:47060	NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5		TI90016067	
12108	15:47061	NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5		TI90016452	
12117	15:46791	NTIS (US Sales Only), PC A05/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50		TI90016450	
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12239	15:46795	NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 8.75		TI90016061	
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12288	15:47062	NTIS (US Sales Only), PC A06/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI90016077	
12301	15:47063	NTIS (US Sales Only), PC A03/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5		TI90016089	
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12442	15:46741	NTIS (US Sales Only), PC A05/MF A01; OSTI; Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI90016085	
12446	15:46487	NTIS (US Sales Only), PC A08/MF A01; Office for Official Publications of the European Communities 2, rue Mercier L-2985 Luxembourg; Price ECU 13.75			
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8520	15:46849	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		TI90638486	
FEW–					
378	15:48051	*See* PB–90-248212/XAB			
FFA-TN–					
1987-12	15:46787	*See* STEV-VIND–90-38			
1987-40	15:46786	*See* STEV-VIND–90-37			
1987-81	15:46803	*See* STEV-VIND–90-31			
1988-1	15:46788	*See* STEV-VIND–90-43			
1989-24	15:46808	*See* STEV-VIND–90-39			
1989-45	15:46797	*See* STEV-VIND–90-21			
1990-01	15:46789	*See* STEV-VIND–90-44			
FMPC–					
2209	15:46658	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016193	MF-731
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1675	15:47421	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90018011	PC-414
FNAL/C–					
89/261-E	15:47869	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016903	MF-414
90/151	15:47806	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016901	MF-414
90/155	15:47807	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016902	MF-414
90/160-E	15:47808	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017264	MF-414
90/170-T	15:47849	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017263	MF-412
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282	15:47780	NTIS (US Sales Only), PC A10/MF A01		DE90514687	
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90-1	15:46659	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-113BR	15:47992	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-16	15:46489	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-22	15:46912	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-67	15:46339	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-70BR	15:46650	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-82BR	15:46913	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
GAO/RCED–					
90-87	15:46742	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
GAO/T-RCED–					
90-33	15:47488	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-45	15:46743	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-47	15:46660	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-52	15:47489	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-55	15:46614	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
90-56	15:46392	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877 (USA)			
GEPP-EV–					
1092	15:47736	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016680	MF-707
GGU-R–					
142	15:46490	NTIS (US Sales Only), PC A03/MF A01		DE90518683	
GL-TR–					
89-0301	15:47480	*See* AD-A–222183/6/XAB			
89-0303	15:47493	*See* AD-A–222187/7/XAB			
GRI–					
89/0138	15:46625	*See* UCRL-CR–104316			
GSI–					
90-06(prepr.)	15:47889	Also published in Z. Phys., A: At. Nuclei (Jul 1990) v. 336(3) p. 263-278			
90-28(prepr.)	15:47893	NTIS (US Sales Only), PC A10/MF A01		DE90519759	
90-29(prepr.)	15:47781	NTIS (US Sales Only), PC A03/MF A01		DE90519760	
90-30(prepr.)	15:47894	Available from Gesellschaft fuer Schwerionen-forschung mbH, Darmstadt (Germany, F.R.)			
90-31(prepr.)	15:47895	NTIS (US Sales Only), PC A03/MF A01		DE90519763	
HCA–					
109-89	15:47663	*See* AD-A–222163/8/XAB			
HIFAN–					
462	15:47997	*See* LBL–29094			
HMI-B–					
472	15:48034	NTIS (US Sales Only), PC A13/MF A01		DE90519739	
HR-EX–					
1962	15:46785	*See* ETSU-TID–4067			
IAE–					
0052	15:47271	*See* CNIC–00240			
0053	15:47272	*See* CNIC–00241			
0055	15:47273	*See* CNIC–00243			
0061	15:47232	*See* CNIC–00249			
0062	15:46856	*See* CNIC–00250			
IAEA-CN–					
53/G-2-8	15:47964	*See* CONF-901025–5			
IAEA-R–					
4947-F	15:47687	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639722	
IAEA-TECDOC–					
514	15:46850	NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS		DE90638487	
540	15:46823	NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS		DE90638397	
546	15:46869	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90638395	
IBM-RR-RJ–					
7595	15:47394	*See* AD-A–222392/3/XAB			
IEPA/LPC–					
90/47	15:46609	*See* PB–90-244203/XAB			
IFP–					
37-154	15:46577	NTIS (US Sales Only), PC A07/MF A01		DE90518454	
37-256	15:46578	NTIS (US Sales Only), PC A08/MF A01		DE90518447	
37-626	15:46491	NTIS (US Sales Only), PC A13/MF A01		DE90518448	
37-664	15:46579	NTIS (US Sales Only), PC A10/MF A01		DE90518453	
IFSR–					
436	15:47972	*See* DOE/ET/53088–436			
443	15:47973	*See* DOE/ET/53088–443			
444	15:47974	*See* DOE/ET/53088–444			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
445	15:47975	*See* DOE/ET/53088–445			
446	15:47749	*See* DOE/ET/53088–446			
56	15:47971	*See* DOE/ET/53088–56			
IFT-P–					
10/89	15:47950	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90637409	
IKU-R–					
22.1874.00/01/89	15:46605	NTIS (US Sales Only), PC A03/MF A01		DE90518764	
INDC(CPR)–					
16	15:47870	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90637876	
INDC(GDR)–					
057	15:47896	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90637862	
INDC(NDS)–					
233	15:47901	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90637763	
INIS-XN–					
254	15:46651	NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS		DE90640187	
INIS-mf–					
12626	15:46879	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90638244	
12690	15:47688	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639724	
12691	15:47782	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90638849	
12692	15:47928	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90638871	
12693	15:47783	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90638829	
12694	15:47680	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90639769	
12695	15:47745	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90638737	
12697	15:48027	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90640202	
12698	15:48028	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90640203	
12699	15:47929	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90638872	
INP–					
1435/S	15:48035	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640196	
1436/PH	15:47826	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639158	
1439/PH	15:47827	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639159	
1441/PH	15:47902	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639194	
1442/AP	15:47909	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639183	
1447/PH	15:47809	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639179	
1456/PH	15:47884	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639230	
INT–					
204/P	15:47903	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639197	
205/I	15:47275	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639255	
206/P	15:47993	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639000	
207/I	15:46732	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639891	
232/I	15:46381	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640132	
234/I	15:47442	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640121	
IPEN-PUB–					
141	15:47373	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639910	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
152	15:47694	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639690	
154	15:47695	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639691	
160	15:47696	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639707	
167	15:46644	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639443	
168	15:47276	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639361	
169	15:46661	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640164	
171	15:46862	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639981	
175	15:47362	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639403	
181	15:47363	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639404	
186	15:46834	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640013	
187	15:46870	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640001	
188	15:46835	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640014	
189	15:46836	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640015	
190	15:46837	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640016	
191	15:46838	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640017	
202	15:46662	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640171	
211	15:47930	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638876	
215	15:47681	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639856	
226	15:46663	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640165	
227	15:47443	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640053	
228	15:47444	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640122	
IPP–					
4/241	15:47976	NTIS (US Sales Only), PC A02/MF A01		DE90519768	
6/292	15:47977	NTIS (US Sales Only), PC A03/MF A01		DE90519767	
6/293	15:47951	NTIS (US Sales Only), PC A03/MF A01		DE90519769	
III/147	15:47978	NTIS (US Sales Only), PC A04/MF A01		DE90519771	
III/157	15:47979	NTIS (US Sales Only), PC A05/MF A01		DE90519770	
IS–					
4922	15:47550	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016714	PC-402
4958	15:46340	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016715	PC-102
4969	15:46341	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016716	PC-102
4970	15:46371	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017298	PC-102
4985	15:46342	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017299	PC-102
4993	15:46343	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017300	PC-102
4994	15:46344	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017301	PC-102
4996	15:46372	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017302	PC-102
4997	15:46345	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017303	PC-102
4998	15:46346	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017304	PC-102
5000	15:46382	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017305	PC-102
5004	15:46383	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017306	PC-102
5005	15:46347	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017307	PC-102
5006	15:46348	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017308	PC-102
5007	15:46384	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017309	PC-102
5013	15:46373	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017310	PC-102
IS-M–					
621	15:46349	NTIS, PC A03/MF A01 - OSTI		DE90016702	PC-102
622	15:47185	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016703	PC-404
624	15:47186	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017416	PC-404
626	15:47187	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016705	PC-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
IS-T–					
1484	15:47277	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016416	MF-401; MF-404
1485	15:47278	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016414	MF-401
1486	15:47132	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016417	MF-401; MF-404
1487	15:47235	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016415	MF-401
ITEF–					
69-89	15:47445	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640078	
IWGFR–					
69	15:46871	NTIS (US Sales Only), PC A18/MF A01 - OSTI		DE90016214	
JINR–					
13-89-117	15:47446	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640060	
13-89-155	15:47447	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640123	
18-89-137	15:47279	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639256	
JINR-E–					
1-89-57	15:47994	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639001	
2-89-123	15:47850	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90638822	
2-89-127	15:47855	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638767	
2-89-144	15:47829	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639103	
2-89-321	15:47856	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638768	
2-89-65	15:47828	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639136	
4-89-110	15:47904	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639185	
JINR-R–					
1-89-119	15:47448	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640079	
1-89-14	15:47784	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638850	
1-89-46	15:47877	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639221	
10-89-40	15:48036	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640197	
15-89-107	15:47449	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90640059	
2-89-217	15:47830	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639124	
2-89-290	15:47952	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638738	
3-89-334	15:47878	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639222	
3-89-408	15:47879	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639223	
5-89-323	15:47953	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638739	
Juel–					
2194	15:46844	NTIS (US Sales Only), PC A08/MF A01		DE90519890	
2355	15:47466	NTIS (US Sales Only), PC A03/MF A01		DE90519860	
K/DSRD–					
446	15:47374	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016201	
K/QT–					
331	15:47236	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016516	MF-501
KCP–					
613-4204	15:46738	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016284	MF-701
KEI–					
1656	15:46865	*See* NUREG/CR–5583			
KEMAKTA-AR–					
89-06	15:46676	*See* SKI–89038			
KFK–					
4467	15:46655	*See* Dounreay-Trans–1030			
4491e	15:46851	NTIS (US Sales Only), PC A10/MF A01		DE90520030	

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4701	15:47188	NTIS (US Sales Only), PC A03/MF A01		DE90519891	
4720	15:47380	NTIS (US Sales Only), PC A04/MF A01		DE90519937	
4723	15:46664	NTIS (US Sales Only), PC A04/MF A01		DE90519889	
4724	15:47189	NTIS (US Sales Only), PC A03/MF A01		DE90519892	
KTM/E-D–					
181	15:46966	NTIS (US Sales Only), PC A05/MF A01		DE90518694	
182	15:46389	NTIS (US Sales Only), PC A06/MF A01		DE90518695	
KU-HCOE-FL2-R–					
90-6	15:47750	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639030	
90-7	15:47190	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639536	
90-8	15:47191	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639537	
90-9	15:47931	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639092	
90-10	15:47932	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639091	
KWU-R–					
321/82/333	15:46839	Copy held by UB/TIB Hannover			
LA–					
11692-MS-Vol.1	15:46880	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016723	
11692-MS-Vol.3	15:47793	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017537	
11692-MS-Vol.4	15:47794	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017535	
11692-MS-Vol.5	15:47795	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017536	
11692-MS-Vol.7	15:47796	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017539	
11692-MS-Vol.8	15:47797	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017538	
11706-MS	15:47454	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016724	MF-706
11834-MS	15:47118	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016656	MF-700; MF-900
11837-MS	15:47481	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017237	
11893-T	15:47785	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016725	MF-410
11903-MS	15:47482	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016558	MF-706
11911-MS	15:47121	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016657	MF-700
LA-UR–					
90-2389	15:47751	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014911	MF-910
90-2623	15:47943	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016468	MF-410
90-2632	15:47933	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016466	MF-406; MF-410
90-2633	15:47944	NTIS, PC A02/MF A01 - OSTI		DE90016720	MF-410
90-2660	15:47954	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016717	MF-910
90-2667	15:47422	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016615	
90-2671	15:47945	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016614	MF-910
90-2677	15:47133	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016613	MF-904
90-2678	15:47134	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016612	MF-704
90-2679	15:47135	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016611	MF-704
90-2688	15:47136	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016571	MF-904
90-2690	15:47810	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016569	MF-910
90-2699	15:47192	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016568	MF-900
90-2708	15:47946	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016567	MF-910
90-2714	15:47955	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016566	MF-905
90-2715	15:47995	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016514	MF-712
90-2717	15:47871	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016513	MF-414
90-2733	15:47624	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016512	MF-908
90-2735	15:47505	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016511	MF-707; MF-706
90-2737	15:47876	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016510	MF-413
90-2739	15:47409	NTIS, PC A02/MF A01 - OSTI		DE90016509	
90-2740	15:47423	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016508	
90-2743	15:47798	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016507	MF-910
90-2744	15:47799	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016506	MF-405
90-2755	15:47956	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016505	MF-910
90-2759	15:47410	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016504	MF-414
90-2764	15:47752	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016495	MF-700
90-2774	15:46494	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016494	MF-906; MF-905
90-2792	15:47193	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016491	MF-704
90-2799	15:47194	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016490	MF-904
90-2801	15:47137	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016489	MF-704
90-2809	15:47411	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016488	
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90-2847	15:47195	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016484	MF-904
90-2851	15:47753	NTIS, PC A03/MF A01 - OSTI		DE90016483	MF-706
90-2854	15:47682	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016447	MF-908; MF-910
90-2887	15:47996	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016439	MF-712
90-2888	15:47413	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016438	
90-2901	15:47424	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016435	
90-2903	15:47754	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016434	MF-910
90-2909	15:47755	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016433	MF-700
90-2915	15:47462	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016432	MF-700
90-2919	15:47414	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016431	MF-414
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257/89	15:47860	*See* NORDITA–89/29-P(prepr.)			
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19735-Rev.1	15:46967	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016622	MF-350
23780	15:46940	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016644	MF-350
24306	15:46944	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016624	MF-350
25077	15:46932	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016628	MF-920
25413	15:46665	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016625	MF-403
26633	15:47683	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016621	MF-408
27182	15:47740	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016623	MF-403
27295	15:46933	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014887	MF-350
28274	15:46968	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016641	MF-350
28470	15:47407	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014890	PC-413
28515	15:46901	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016648	MF-210
28560	15:46969	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016649	MF-350
28594	15:46626	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014886	
28616	15:46941	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016630	MF-224
28762	15:46945	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016635	MF-600
28819	15:46666	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016642	MF-403
29078	15:47111	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016639	MF-210
29094	15:47997	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90014895	PC-411
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29138	15:46902	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016638	MF-210
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1970	15:47392	*See* AD-A–221977/2/XAB			
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0003	15:47567	*See* CNIC–00285			
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402/90	15:47981	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90637550	
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89-15	15:47851	*See* UM-P–89/91			
MBL–					
1989-12	15:47701	*See* PB–90-246984/XAB			
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3640	15:47490	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016662	PC-700
3652(OP)	15:47483	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015742	MF-742
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89-12	15:46667	Available from Nagra, CH-5401 Baden, Switzerland			
NBI-HE–					
89-27	15:47857	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638769	
89-28	15:47858	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638770	
90-16	15:47859	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638771	
90-28	15:47786	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638862	
NEDO-P–					
8907	15:46374	NTIS (US Sales Only), PC A06/MF A01		DE90517225	
8912	15:46781	NTIS (US Sales Only), PC A14/MF A01		DE90517230	
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8924	15:46962	NTIS (US Sales Only), PC A13/MF A01		DE90517223	
8925	15:46906	NTIS (US Sales Only), PC A13/MF A01		DE90517222	
8926	15:46780	NTIS (US Sales Only), PC A05/MF A01		DE90517228	
8934	15:46921	NTIS (US Sales Only), PC A09/MF A01		DE90517229	
8937	15:46904	NTIS (US Sales Only), PC A06/MF A01		DE90517227	
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349/FN-2.331-0.86	15:46970	NTIS (US Sales Only), PC A03/MF A01; NEFF Secretariat, P.O. Box 1564, CH-4001 Basel, Switzerland		DE90513606	
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1005	15:47066	NTIS (US Sales Only), PC A03/MF A01		DE90518706	
101	15:46971	NTIS (US Sales Only), PC A04/MF A01		DE90518705	
118	15:47076	NTIS (US Sales Only), PC A03/MF A01		DE90518700	
120	15:46972	NTIS (US Sales Only), PC A07/MF A01		DE90518709	
121	15:47065	NTIS (US Sales Only), PC A04/MF A01		DE90518710	
122	15:46817	NTIS (US Sales Only), PC A03/MF A01		DE90518737	
96	15:47064	NTIS (US Sales Only), PC A05/MF A01		DE90518707	
98	15:46947	NTIS (US Sales Only), PC A08/MF A01		DE90518704	
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1989-8	15:47425	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638354	
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89/29-P(prepr.)	15:47860	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90638772	
89/30-P(prepr.)	15:47861	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638773	
90/12-A(prepr.)	15:47756	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639034	
90/14-A(prepr.)	15:47757	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639035	
90/2-P(prepr.)	15:47862	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638774	
NPT-ESTD-L–					
0071-R89	15:46845	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638480	
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0386-Digest.5-Rev.7	15:46853	NTIS, PC A99/MF A01 - GPO; OSTI; INIS		TI90015902	
0525-Rev.16	15:46724	NTIS, PC A16/MF A01 - GPO; OSTI; INIS		TI90016728	
1272-Vol.4-No.1	15:46882	NTIS, PC A12/MF A01 - GPO; OSTI; INIS		TI90016408	
1272-Vol.4-No.2	15:46729	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI90016409	
1420	15:46883	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI90017332	
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2850-Vol.9	15:47697	NTIS, PC A09/MF A01 - GPO; OSTI; INIS		TI90017086	
4674-Vol.11	15:46884	NTIS, PC A08/MF A01 - GPO; OSTI; INIS		TI90016928	
4674-Vol.12	15:46885	NTIS, PC A22/MF A01 - GPO; OSTI; INIS		TI90016926	
4744-Vol.3-No.2	15:46826	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90017225	
4908	15:46864	NTIS, PC A07/MF A01 - GPO - OSTI		TI90016320	
5297	15:46855	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90017229	
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3706	15:47787	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016727	MF-405
3709	15:47957	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015975	MF-406
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3717	15:47714	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017501	MF-407
3718	15:46846	NTIS, PC A03/MF A01 - OSTI		DE90016878	MF-522
3720	15:47939	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017313	MF-406
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3735	15:47872	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017560	MF-413
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1007	15:46973	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016499	MF-350
1198	15:47477	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016131	
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232-Vol.11	15:46884	*See* NUREG/CR–4674-Vol.11			
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11012	15:47381	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016659	MF-316
11481	15:47998	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014778	MF-700
11538	15:47508	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016687	
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90-06	15:47831	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639104	
90-09	15:47887	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639233	
90-11	15:47906	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639199	
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90-241837/XAB	15:46783	NTIS, PC A11/MF A02			
90-241944/XAB	15:47574	NTIS, PC A03/MF A01			
90-241951/XAB	15:47575	NTIS, PC A03/MF A01			
90-241969/XAB	15:47576	NTIS, PC A03/MF A01			
90-241977/XAB	15:47577	NTIS, PC A02/MF A01			
90-242074/XAB	15:47578	NTIS, PC A04/MF A01			
90-242314/XAB	15:47512	NTIS, PC A08/MF A01			
90-242363/XAB	15:47717	NTIS, PC A03/MF A01			
90-243957/XAB	15:47553	NTIS, PC A03/MF A01			
90-243965/XAB	15:47579	NTIS, PC A03/MF A01			
90-243981/XAB	15:47580	NTIS, PC A03/MF A01			
90-244005/XAB	15:47581	NTIS, PC A02/MF A01			
90-244013/XAB	15:47582	NTIS, PC A03/MF A01			
90-244021/XAB	15:47583	NTIS, PC A03/MF A01			
90-244039/XAB	15:46607	NTIS, PC A03/MF A01			
90-244047/XAB	15:47584	NTIS, PC A03/MF A01			
90-244062/XAB	15:47585	NTIS, PC A03/MF A01			
90-244070/XAB	15:47586	NTIS, PC A03/MF A01			
90-244088/XAB	15:47587	NTIS, PC A03/MF A01			
90-244096/XAB	15:47588	NTIS, PC A03/MF A01			
90-244104/XAB	15:47589	NTIS, PC A03/MF A01			
90-244112/XAB	15:46608	NTIS, PC A03/MF A01			
90-244120/XAB	15:47590	NTIS, PC A03/MF A01			
90-244187/XAB	15:47591	NTIS, PC A03/MF A01			
90-244195/XAB	15:47592	NTIS, PC A03/MF A01			
90-244203/XAB	15:46609	NTIS, PC A09/MF A02			
90-244229/XAB	15:47593	NTIS, PC A03/MF A01			
90-244237/XAB	15:47594	NTIS, PC A03/MF A01			
90-244369/XAB	15:46956	NTIS, PC A04/MF A01			
90-244377/XAB	15:46622	NTIS, PC A06/MF A01			
90-244385/XAB	15:46957	NTIS, PC A04/MF A01			
90-244690/XAB	15:47788	NTIS(Order as PB90-244658)			
90-244823/XAB	15:47595	NTIS, PC A03/MF A01			
90-245242/XAB	15:47513	NTIS, PC A03/MF A01			
90-245259/XAB	15:47514	NTIS, PC A02/MF A01			
90-245275/XAB	15:46610	NTIS, PC A03/MF A01			
90-245283/XAB	15:47596	NTIS, PC A03/MF A01			
90-245341/XAB	15:47515	NTIS, PC A02/MF A01			
90-245465/XAB	15:47718	NTIS, PC A03/MF A01			
90-245515/XAB	15:47597	NTIS, PC A03/MF A01			
90-245671/XAB	15:47516	NTIS, PC A02/MF A01			
90-245689/XAB	15:47517	NTIS, PC A03/MF A01			
90-245697/XAB	15:47518	NTIS, PC A02/MF A01			
90-245713/XAB	15:47519	NTIS, PC A03/MF A01			
90-245721/XAB	15:47554	NTIS, PC A02/MF A01			
90-245770/XAB	15:47719	NTIS, PC A02/MF A01			
90-245788/XAB	15:47720	NTIS, PC A02/MF A01			
90-245812/XAB	15:47598	NTIS, PC A03/MF A01			
90-245838/XAB	15:47721	NTIS, PC A02/MF A01			
90-245853/XAB	15:47520	NTIS, PC A02/MF A01			
90-245879/XAB	15:47722	NTIS, PC A02/MF A01			
90-245929/XAB	15:46479	NTIS, PC A02/MF A01			
90-245945/XAB	15:47723	NTIS, PC A03/MF A01			
90-245952/XAB	15:47724	NTIS, PC A02/MF A01			
90-245978/XAB	15:47725	NTIS, PC A02/MF A01			
90-246018/XAB	15:47726	NTIS, PC A03/MF A01			
90-246091/XAB	15:47521	NTIS, PC A07/MF A01			
90-246141/XAB	15:47280	NTIS, PC A04/MF A01			
90-246174/XAB	15:47522	NTIS, PC A03/MF A01			
90-246182/XAB	15:46615	NTIS, PC A03/MF A01			
90-246216/XAB	15:47523	NTIS, PC A03/MF A01			
90-246232/XAB	15:47524	NTIS, PC A03/MF A01			
90-246240/XAB	15:47525	NTIS, PC A03/MF A01			
90-246257/XAB	15:47526	NTIS, PC A03/MF A01			
90-246265/XAB	15:47527	NTIS, PC A03/MF A01			

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90-246323/XAB	15:47528	NTIS, PC A03/MF A01			
90-246331/XAB	15:47529	NTIS, PC A03/MF A01			
90-246349/XAB	15:47371	NTIS, PC A02/MF A01			
90-246356/XAB	15:47530	NTIS, PC A03/MF A01			
90-246364/XAB	15:46753	NTIS, PC A03/MF A01			
90-246414/XAB	15:47531	NTIS, PC A03/MF A01			
90-246463/XAB	15:47599	NTIS, PC A03/MF A01			
90-246513/XAB	15:47600	NTIS, PC A13/MF A02			
90-246547/XAB	15:47601	NTIS, PC A03/MF A01			
90-246554/XAB	15:47602	NTIS, PC A03/MF A01			
90-246562/XAB	15:47603	NTIS, PC A03/MF A01			
90-246570/XAB	15:47604	NTIS, PC A03/MF A01			
90-246588/XAB	15:47605	NTIS, PC A03/MF A01			
90-246596/XAB	15:47606	NTIS, PC A03/MF A01			
90-246604/XAB	15:47607	NTIS, PC A03/MF A01			
90-246612/XAB	15:47608	NTIS, PC A03/MF A01			
90-246620/XAB	15:46611	NTIS, PC A03/MF A01			
90-246752/XAB	15:47067	NTIS, PC A09/MF A01			
90-246984/XAB	15:47701	NTIS, PC A03/MF A01			
90-247024/XAB	15:47609	NTIS, PC A02/MF A01			
90-247032/XAB	15:47610	NTIS, PC A03/MF A01			
90-247065/XAB	15:47611	NTIS, PC A03/MF A01			
90-247073/XAB	15:47612	NTIS, PC A03/MF A01			
90-247081/XAB	15:47613	NTIS, PC A03/MF A01			
90-247099/XAB	15:47555	NTIS, PC A03/MF A01			
90-247198/XAB	15:47532	NTIS, PC A06/MF A01			
90-247222/XAB	15:46627	NTIS, PC A09/MF A01			
90-247248/XAB	15:46974	NTIS, PC A14/MF A02			
90-247255/XAB	15:46478	NTIS, PC A06/MF A01			
90-247271/XAB	15:46628	NTIS, PC A07/MF A01			
90-247289/XAB	15:46975	NTIS, PC A09/MF A01			
90-247362/XAB	15:47281	NTIS, PC A03/MF A01			
90-247370/XAB	15:47110	NTIS, PC A05/MF A01			
90-247453/XAB	15:47533	NTIS, PC A09/MF A02			
90-247487/XAB	15:47534	NTIS, PC A07/MF A01			
90-247495/XAB	15:47535	NTIS, PC A05/MF A01			
90-247586/XAB	15:47068	NTIS, PC A08/MF A01			
90-248212/XAB	15:48051	NTIS, PC A03/MF A01			
90-249442/XAB	15:47536	NTIS, PC A21/MF A03			
90-250168/XAB	15:46822	NTIS, PC A04/MF A01			
90-250406/XAB	15:47614	NTIS, PC A03/MF A01			
90-250416/XAB	15:46612	NTIS, PC A03/MF A01			
90-252503/XAB	15:47537	NTIS, PC A17/MF A03			
90-502428/XAB	15:46761	NTISCP D05			
PINSTECH/RIAD–					
118	15:47282	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639257	
PNL–					
4221-Vol.9	15:47697	*See* NUREG/CR–2850-Vol.9			
4223	15:46670	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014366	MF-510
6196	15:46864	*See* NUREG/CR–4908			
7136	15:47702	National Energy Software Center (software packages requested by U.S. Government Agencies and Their Contractors), Argonne National Laboratory, Argonne, IL (312-972-7250 or FTS 972-7250). Other requestors should be directed to PNL			ND-602; ND-630
7170	15:47615	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016665	MF-802
7200-Pt.3	15:47538	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016660	MF-402
7224-Vol.1	15:46976	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016007	MF-350
7438	15:47703	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015972	MF-602
PNL-SA–					
17201	15:46852	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016342	
17205	15:47478	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017191	MF-505
17225	15:47251	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017186	MF-404
17230	15:47789	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017144	MF-404
17379	15:46671	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016330	MF-812
17429	15:47539	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016296	MF-501; MF-506
17526	15:47382	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016361	MF-504
17536	15:47540	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016356	MF-402

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17594	15:47704	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016536	MF-407
17621	15:47171	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016565	MF-404
17695	15:47686	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017189	MF-402
17711	15:47471	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016555	MF-506
17741	15:47705	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017195	MF-408
17750	15:46375	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016309	MF-401
17757	15:46720	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017194	MF-507
17819	15:47733	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017190	MF-408
17825	15:47172	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017192	MF-504
17847	15:46672	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016339	MF-510
17918-HEDR	15:47689	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017196	MF-708
17987	15:47541	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016338	MF-402
17988	15:47542	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016540	MF-502
17992	15:46818	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016539	MF-202
18037	15:46725	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016294	MF-700
18052	15:47885	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016329	MF-414
18054	15:47556	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016561	MF-402
18059	15:47252	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017143	MF-404
18088	15:47479	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016332	
18090	15:48052	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016291	MF-506
18118	15:47616	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016331	MF-502
18138	15:46721	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016563	MF-510
18160	15:46887	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016533	MF-520
18162	15:46958	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016328	MF-114
18314	15:47734	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016554	MF-220
18352	15:47617	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016564	MF-502
18380	15:47706	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017140	MF-507
18383	15:47218	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016534	MF-404
18391	15:47707	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90017193	MF-507
18409	15:48053	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017141	MF-506
18411	15:46673	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016424	MF-512
18412	15:46648	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016559	MF-512
18413	15:46674	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016537	MF-512
POEF-T–					
3533	15:47472	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015783	MF-506
PPPL–					
2706	15:47982	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016670	PC-420; PC-427
PSI–					
47	15:46857	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90639978	
57	15:47386	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90638364	
59	15:46888	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638254	
61	15:48054	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638686	
63	15:47918	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638285	
64	15:46889	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638255	
65	15:47309	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90636476	
66	15:47253	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638129	
68	15:47790	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90638869	
74	15:47310	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90639370	
PSR–					
1687	15:47690	*See* AD-A–222240/4/XAB			
1865	15:47691	*See* AD-A–222398/0/XAB			
RAL–					
90-022	15:47959	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90706209	
RAND/R–					
3745-ACQ	15:47117	*See* AD-A–222352/7/XAB			
RINPO–					
0005	15:46858	*See* CNIC–00262			
0006	15:46828	*See* CNIC–00290			
0007	15:46830	*See* CNIC–00299			

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RISO-M–					
2864	15:48029	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90640207	
RIVM–					
678902-002	15:47058	Rijksinstituut voor Volksgezondheid en Milieuhygiene, P.O. Box 1, 3720 BA Bilthoven, Netherlands			
SAIC–					
89/1483	15:47767	*See* AD-A–222239/6/XAB			
SAND–					
89-0864	15:48055	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014855	MF-906
89-0865	15:48056	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014856	MF-906
89-0866	15:48057	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014857	MF-906
89-2304	15:48016	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016688	PC-420; PC-421; PC-422; PC-423;
89-2771C	15:47219	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015990	MF-701; MF-704
89-2877C	15:47460	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015714	MF-700
89-2878C	15:47461	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015716	MF-700
90-0375-Vol.5	15:46668	*See* NUREG/CR–5453-Vol.5			
90-0593	15:47254	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014859	MF-704; MF-705
90-0647C	15:47311	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016104	MF-704
90-0935C	15:47069	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016106	MF-233
90-1003C	15:48017	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017042	MF-712
90-1167	15:48018	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016691	PC-420; PC-421; PC-422; PC-423;
90-1491C	15:48019	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017043	MF-712
90-1583C	15:47387	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015712	MF-706
90-2018C	15:48020	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90015992	MF-420
90-2060C	15:47283	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017592	MF-704
90-2255C	15:48058	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016222	MF-705
90-2287C	15:47426	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016896	MF-712
90-2313C	15:46890	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016869	
90-7032	15:47070	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014852	MF-275
900-0165	15:48059	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014858	MF-706
SERI/TP–					
210-3833	15:46776	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000341	MF-270
232-3597	15:46740	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009511	MF-244
260-3729	15:46922	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000347	MF-233
SI/R–					
881008	15:46914	NTIS (US Sales Only), PC A03/MF A01		DE90518765	
SINRE–					
0020	15:46859	*See* CNIC–00292			
SINS–					
2075/P-8/PH/A	15:47832	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90639137	
2076/P-1/PL/A	15:47886	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639231	
2079/P-1/PL/B	15:47881	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90639227	
2086/P-5/PP/A	15:48021	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639019	
SIP–					
0033	15:47942	*See* CNIC–00283			
SIS–					
1989:2	15:47919	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639750	
1990:1	15:47920	NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS		DE90639759	
1990:2	15:47921	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639760	
1990:4	15:47922	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639761	
1990:5	15:47450	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640054	

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SKB-TR–					
89-31	15:47742	NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS		DE90639671	
89-35	15:46675	NTIS (US Sales Only), PC A09/MF A01; OSTI; INIS		DE90637312	
SKI–					
89038	15:46676	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90640173	
SLAC–					
368	15:48060	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016696	PC-405
369	15:47812	NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90018003	PC-414
370	15:48061	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016695	PC-405
SLAC-PUB–					
5292	15:47427	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016686	MF-414
5299	15:47408	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016684	MF-414
5302	15:47415	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016682	MF-414
5304	15:47416	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016685	MF-414
5305	15:47451	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016679	MF-406
5312	15:47833	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016678	MF-414
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497	15:47923	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638271	
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89-183	15:47774	*See* AD-A–222560/5/XAB			
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19	15:47557	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017254	MF-702
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90-27	15:46800	NTIS (US Sales Only), PC A02/MF A01		DE90518775	
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90-41	15:46809	NTIS (US Sales Only), PC A02/MF A01		DE90518769	
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UBA-FB–					
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20622-88-2	15:47122	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016677	MF-701
21406-Rev.1	15:47743	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016652	MF-800
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101604	15:48022	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015904	MF-700
102583	15:47473	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015906	MF-706
102807	15:47255	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015909	MF-701; MF-706
52000-90-5/6	15:47744	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014837	PC-700
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103401	15:47727	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015912	MF-702; MF-708
104316	15:46625	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016474	
104544	15:47256	NTIS, PC A03/MF A01 - OSTI		DE90015910	MF-701; MF-704
104570	15:48063	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016864	MF-700
104574	15:47474	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016212	MF-706
104639	15:47484	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016865	MF-700
104658	15:48064	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016862	MF-705
104659	15:48065	NTIS, PC A04/MF A01 - OSTI		DE90016863	MF-705
104777	15:48066	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015907	MF-705
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103345	15:47312	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90014830	
104197	15:46677	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016675	MF-702
104342	15:47618	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016653	MF-702
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103337	15:48023	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016479	MF-712
103469	15:47173	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016481	
103654	15:47485	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016482	MF-404
104336	15:47463	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016475	MF-706
104453	15:46726	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016469	MF-700
104488	15:46727	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016471	MF-700
104541	15:47491	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015903	MF-742
104586	15:47375	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016472	MF-702
104734	15:47543	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90015908	MF-403
104774	15:48024	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90018009	MF-516
104776	15:47428	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016476	
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103710	15:47119	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90016650	PC-700
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90-63	15:47814	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016791	MF-414
90-65	15:47815	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016790	MF-414
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89/68	15:47837	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639161	
89/91	15:47851	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638823	
89/96	15:47852	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90638824	
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89-4198	15:47578	*See* PB–90-242074/XAB			
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90-01	15:47366	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90639405	
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90-6	15:47983	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90016672	PC-427
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89-2	15:47984	NTIS, PC A09/MF A01; OSTI; INIS		DE90016671	PC-427
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1082	15:47388	NTIS (US Sales Only), PC A03/MF A01		DE90518712	
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0182-26	15:46681	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017231	MF-721
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0937	15:46684	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017234	MF-900
0962	15:46685	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017246	MF-900
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0591-Rev.1	15:46686	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017245	MF-721
0592	15:46876	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90017267	MF-700
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The correlation list is provided for those organizations that file documents by report number but may receive requests by order number. For more information about a document, refer to the Report Number Index.

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Document Types

- J Journal article
- TJ Translation of a journal article
- R Report
- RA Report analytic
- B Book
- BA Book analytic
- P Patent
- E Engineering materials
- D Dissertation
- TG Translation (general)
- TA Translation (analytic)

Country Codes

- AD Andorra
- AE United Arab Emirates
- AF Afghanistan
- AL Albania
- AR Argentina
- AT Austria
- AU Australia
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- BD Bangladesh
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- BJ Benin
- BM Bermuda
- BO Bolivia
- BR Brazil
- BS Bahamas
- BT Bhutan
- BU Burma
- BW Botswana
- BY Byelorussian Soviet Socialist Republic (Byelorussian SSR)
- CA Canada
- CB Khmer Republic
- CF Central African Republic
- CG Congo
- CH Switzerland
- CI Ivory Coast
- CL Chile
- CM United Republic of Cameroon
- CN China
- CO Colombia
- CR Costa Rica
- CS Czechoslovakia
- CU Cuba
- CY Cyprus
- DD German Democratic Republic
- DE Germany, Fed. Republic of (F.R. Germany)
- DK Denmark
- DO Dominican Republic
- DZ Algeria
- EC Ecuador
- EG Egypt
- ES Spain
- ET Ethiopia
- FI Finland
- FJ Fiji
- FR France
- GA Gabon
- GB United Kingdom of Great Britain and Northern Ireland (UK)
- GD Grenada
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- GN Guinea
- GQ Equatorial Guinea
- GR Greece
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- GY Guyana
- HK Hong Kong
- HN Honduras
- HT Haiti
- HU Hungary
- HV Upper Volta
- ID Indonesia
- IE Ireland
- IL Israel
- IN India
- IQ Iraq
- IR Iran
- IS Iceland
- IT Italy
- JM Jamaica
- JO Jordan
- JP Japan
- KE Kenya
- KH Democratic Kampuchea
- KP Democratic People's Republic of Korea
- KR Korea, Republic of
- KW Kuwait
- LA Laos
- LB Lebanon
- LI Liechtenstein
- LK Sri Lanka
- LR Liberia
- LS Lesotho
- LU Luxembourg
- LY Libyan Arab Republic
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- SL Sierra Leone
- SM San Marino
- SN Senegal
- SO Somalia
- SU Union of Soviet Socialist Republics (USSR)
- SV El Salvador
- SY Syria
- SZ Swaziland
- TD Chad
- TG Togo
- TH Thailand
- TN Tunisia
- TO Tonga
- TR Turkey
- TT Trinidad and Tobago
- TW Taiwan
- TZ United Republic of Tanzania
- UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
- UG Uganda
- US United States of America (USA)
- UY Uruguay
- VA Holy See
- VE Venezuela
- VI Virgin Islands of the United States
- VN Viet Nam
- WS Western Samoa
- YD Democratic Yemen
- YE Yemen
- YU Yugoslavia
- ZA South Africa
- ZM Zambia
- ZR Zaire
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